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Impacts and consequences of non-standard cots C4I system acquisition upon associated programs of record

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THESIS

IMPACTS AND CONSEQUENCES OF NON-STANDARD COTS C4I SYSTEM ACQUISITION UPON ASSOCIATED PROGRAMS OF RECORD

by

Ted W. L. Huskey

September 2007

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Despite years of reform, DoD acquisition system does not field capabilities quickly enough to meet warfighter requirements. DoD acquisition can not keep pace with the rate of C4I technology growth and is encumbered by layers of procedural bureaucracy. Subsequently existing Programs of Record were harmed by the resulting non-standard acquisitions.

More reform is neither necessary nor the panacea. Adequate processes and programs exist to expedite the fielding of new capabilities. Optimization of existing processes and programs combined with greater warfighter involvement are necessary to prevent future occurrences of non-standard acquisition.

Adherence to existing rules and regulations when combined with reduction of bureaucracy will reduce future occurrences of non-standard COTS C4I equipment acquisition and speed the fielding of new capabilities.

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IMPACTS AND CONSEQUENCES OF NON-STANDARD COTS C4I SYSTEM ACQUISITION UPON ASSOCIATED PROGRAMS OF RECORD

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	**Definition**
ADSI	Air Defense System Integrator
ATD	Advanced Technology Demonstrations
ACTD	Advanced Concept Technology Demonstrations
AIS	Automated Information Systems
AOA	Analysis of Alternatives
AOR	Area of Responsibility
ASTMP	Army Science and Technology Master Plan
AT&L	Acquisition, Technology and Logistics
BLOS	Beyond-Line-of-Sight
BG	Battle Group
C3F	Commander Third Fleet
C4I	Command, Control, Communications, Computers and Intelligence
C5F	Commander Fifth Fleet
C7F	Commander Seventh Fleet
CFFC	Commander, Fleet Forces Command
CG	Guided Missile Cruiser
CIC	Combat Information Center
CINCPACFLT	Commander In Charge Pacific Fleet
CJCS	Chairman of Joint Chiefs of Staff
CLIP	Common Link Integration Processor
CNO	Chief of Naval Operations
COCOM	Combatant Commander
CONOPS	Concepts of Operations
COTS	Commercial-of-the-Shelf
CR	Concept Refinement
CSG	Carrier Strike Group
CTOP	Common Tactical Operational Picture
CVBG	Aircraft Carrier Battle Group

DAG	Defense Acquisition Guide
DAU	Defense Acquisition University
DDG	Guided Missile Destroyer
DoD	Department of Defense
DSD	Deputy Secretary of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities
EA	Evolutionary Acquisition
EC	Enabling Capabilities
ESG	Expeditionary Strike Group
FNC	Future Naval Capabilities
GCCS	Global Command and Control System
GPS	Global Positioning System
GWOT	Global War on Terrorism
HVU	High Value Unit
IER	Information Exchange Requirements
IWN	Immediate Warfighting Need
JC2	Joint Command and Control
JCIDS	Joint Capabilities Integration and Development System
JCTD	Joint Capability Technology Demonstrations
JICO	Joint Information Control Officer
JPG	Joint Programming Guidance
JRAC	Joint Rapid Acquisition Cell
JSS	JICO Support System
JTF	Joint Task Forces
JUON	Joint Urgent Operational Need
KPP	Key Performance Parameter
TDL	Tactical Data Links
NDI	Non-Developmental Item
NGC2P	Next Generation Command and Control Processor
O&S	Operations and Support
OEF	Operation Enduring Freedom

OMB	Office of Management and Budget
OMN	Operations and Maintenance Navy
OPN	Other Procurement Navy
OPNAV	Office of the Chief of Naval Operations
OSD	Office of the Secretary of Defense
P&D	Production and Deployment
PMW	Program Manager Warfare
POM	Program Objective Memorandum
POR	Programs of Record
PPBE	Planning, Programming, Budgeting and Execution
RCIP	Rapid Capability Insertion Program
RDC	Rapid Deployment Capability
RGS	Requirement Generation System
S&T	Science and Technology
SA	Situational Awareness
SDD	System Development and Demonstration
SPAWAR	Space and Naval Warfare Command
SPG	Strategic Planning Guidance
TD	Technology Development
TDMA	Time Division Multiple Access
TDLMP	Tactical Data Link Management Plan
TFCC	Task Force Combat Center
TR	Trouble Report
UAV	Unmanned Aerial Vehicles
WRAP	Warfighters Rapid Acquisition Program

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EXECUTIVE SUMMARY

In order to meet the complex, asymmetrical and non-traditional threats of the twenty-first century, today's warfighter requires an extensive array of capabilities. The most critical of these capabilities are the Command, Control, Communications, Computers and Intelligence (C4I) systems. C4I systems allow the commander to make usable the varied and voluminous information and data permeating the battle space.

Technical innovations and advances in the information technology and computing sectors are the prime drivers in the evolution of information communications. The rate of technology change; both in capability (rising) and cost (falling), is staggering and significantly impacts the Navy’s acquisition of C4I systems. Keeping pace with technology; technology refresh, is difficult. It is challenging in the private sector and even more so in the Department of Defense (DoD). DoD acquisition is attempting to keep pace with the warfighter’s demand for more capability sooner through acquisition reform.

The DoD acquisition system is guided by directives, regulations and rules. Effecting change in such a process-specific and physically large enterprise is difficult. None-the-less, DoD acquisition has been "reforming" for well over thirty years with the goal of providing the warfighter "what he needs when he needs it." Despite years of reform initiates, such as evolutionary and spiral acquisition, and the JCIDS process, the warfighter still bemoans the slowness in fielding C4I systems. Some, citing the exegeses of the Global War on Terrorism (GWOT), have gone so far as to acquire commercial-of-the-shelf (COTS) C4I systems in lieu of waiting on formal acquisition channels to deliver requested capabilities. Such was the case with the Navy's fielding of the Air Defense System Integrator (ADSI) to meet the global war on terror (GWOT) driven warfighter tactical data link (TDL) needs.

TDLs provide the bridge or pathway for equipped units to exchange tactical information. TDLs allow participating units to share tactical information such as their own position, location of friendly forces, enemy positions, threats and warnings,

command and control instructions, and force orders (to name a few) in real-time. The synergy from this information exchange ensures that each participant, including higher headquarters and command elements, share a common tactical operational picture (CTOP) which translates into efficient and coordinated use of forces.

The GWOT changed how battle groups deploy. Many ships, particularly large deck and command ships, were not equipped to handle the new TDL demands. Requests for assistance started pouring in with the commencement of Operation Enduring Freedom (OEF). The Link 16 communication demands varied depending upon a ship's mission and existing TDL capability configuration. The new TDL requirements fell into two categories: add beyond line-of-sight Link 16 capability and remotely display Link 16 information for the Battle Group staff.

The Fleet articulated their needs up their chain of command and the requests were forward to the Navy's tactical data link acquisition program office. The program office concluded it did not have a program of record (POR) that would provide the requested capabilities within the desired time frame. Having no other option, individual units purchased ADSIs directly from the manufacturer, outside standard acquisition. The ADSIs success resulted in the program office's fielding, at OPNAV's direction, 30 ADSIs. Supporting the 30 ADSIs significantly impacted existing PORs. Resource to field the ADSI would have to come from existing PORs. The reallocation of POR resources retarded existing and future PORs.

In addition to the impact on corresponding PORs, analysis of the cause and consequences of the non-standard C4I COTS acquisition revealed that non-standard acquisitions is not completely preventable. In spite reform programs such as JCTDs, WRAPs, and the JRAC, acquisition continues to be layers of regulations and volumes of directives that perpetuate bureaucratic delays.

If DoD's acquisition goal is to provide the warfighter "what he needs when he needs it," then it must field C4I capabilities quicker by optimizing existing regulations and directives that guide the process and fostering greater warfighter/operator involvement in the process.

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I. INTRODUCTION

A. BACKGROUND

Sea Power 21 is the Navy's "strategy that will fully integrate U.S. naval forces into joint operations against regional and transnational dangers" (Bucchi and Mullen, 2002). In describing his vision of Sea Power 21, Chief of Naval Operations Admiral Vern Clark stated, "Future naval operations will use revolutionary information superiority and dispersed, networked force capabilities to deliver unprecedented offensive power, defensive assurance, and operational independence to Joint Force Commanders (Clark, 2002)." That future is upon us.

Given the complex nature of today's asymmetrical and non-traditional threats, the warfighter requires an extensive array of capabilities. The most critical of these capabilities are the Command, Control, Communications, Computers and Intelligence (C4I) systems. C4I systems allow the commander to make usable the varied and voluminous information or data permeating the battles space. C4I systems are the key enablers of ForceNet, the 'glue' that binds the three tiers of Sea Power 21: Sea Strike, Sea Shield, and Sea Basing. ForceNet "is the operational construct and architectural framework for naval warfare in the information age, integrating warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force (Commercial Technology Transition Officer, 2006)."

Technical innovations and advances in the information technology and computing sectors are the prime drivers in the evolution of information communications. The exponential growth rate in the number of transistors in a computer chip, postulated in 1965 by Fairchild Semiconductor's Gordon E. Moore, *Moore's Law*, fairly represents the rate or degree of advance in information communications (Jorgenson 2002). The rate of technology change; both in capability (rising) and cost (falling), is staggering and significantly impacts the Navy's acquisition of C4I systems.

Keeping pace with technology and technology refresh, is difficult. It is challenging in the private sector and even more so in the Department of Defense (DoD). That being said, DoD acquisition regulations have tried to keep pace with the

warfighter's demand for more capability sooner. DoD acquisition reform is active, but the warfighter still bemoans the slowness in fielding C4I systems. Some, citing the urgency of the Global War on Terrorism (GWOT), have gone so far as to acquire comparable available commercial-of-the-shelf (COTS) systems in lieu of waiting on formal acquisition channels, particularly in the area of C4I.

This thesis examines the impact and consequences of non-standard COTS C4I systems' acquisition on associated programs of record (POR), using the acquisition of the Air Defense System Integrator (ADSI) as a case study.

B. RESEARCH OBJECTIVE

The objective of this research is to analyze both the circumstance under which and the consequences of non-standard C4I acquisition and fielding of COTS C4I equipments and the impact upon similar capability Programs of Record using a case study of the Navy's acquisition of the ADSI. Additionally, it will analyze the practices, methodologies, and philosophies that could be implemented to prevent future occurrences. Analysis will yield lessons that may be helpful to system engineers, acquisition managers and students studying acquisition.

C. RESEARCH QUESTIONS

1. Primary Research Questions

What are the causes, impacts, and consequences of non-standard COTS C4I acquisitions and what strategies or procedures can improve them?

2. Subsidiary Research Questions

What mechanism does the Fleet use to articulate their C4I needs to the acquisition program offices?

How are emerging COTS C4I systems brought to the attention of relevant acquisition program offices?

What is the relationship between industry, program sponsors, and C4I system acquisition program offices with respect to emerging technologies and current programs with similar capabilities?

How are COTS C4I systems able to be fielded outside existing acquisition rules?

What strategy must be developed to prevent future occurrences?

D. SCOPE

The scope of this thesis includes the independent description of the non-standard acquisition of C4I systems; circumstances that resulted in the non-standard acquisition; financial and programmatic consequences of the non-standard acquisition; the major tenants, challenges, and benefits of standard acquisition; and recommendations to prevent future negative occurrences.

E. METHODOLOGY

The methodology used in this thesis consisted of the following steps.

- Conducted comprehensive interviews in person, or by telephone, with the Program Manager Warfare 150 (PMW 150), ADSI Assistant Program Manager, OPNAV, and industry personnel involved in the development of non-standard acquisition issues.
- Conducted a comprehensive analysis of the information gathered with respect to the non-standard acquisition of the COTS C4I system and their impact upon the program manager.
- Synthesized analysis with business and readiness considerations to depict the results to date of the non-standard acquisition and recommend future actions.

F. ORGANIZATION

This thesis consists of six chapters: an introduction, three developmental chapters, an analysis chapter, and a conclusion and recommendation chapter and is illustrated in Figure 1. Chapter I is an introduction. Chapter II is a review of standard Navy C4I acquisition methodologies with respect to emerging technologies. Chapter III describes the influences that precipitated the non-standard acquisition of a COTS C4I system. Chapter IV identifies the major impacts of non-standard acquisition COTS C4I systems on the war fighter, existing POR, future POR and the associated organizational and cultural challenges. Chapter V is an analysis of the proposal to prevent reoccurrence and potential application to other C4I programs. Chapter VI presents the conclusions and recommendations.

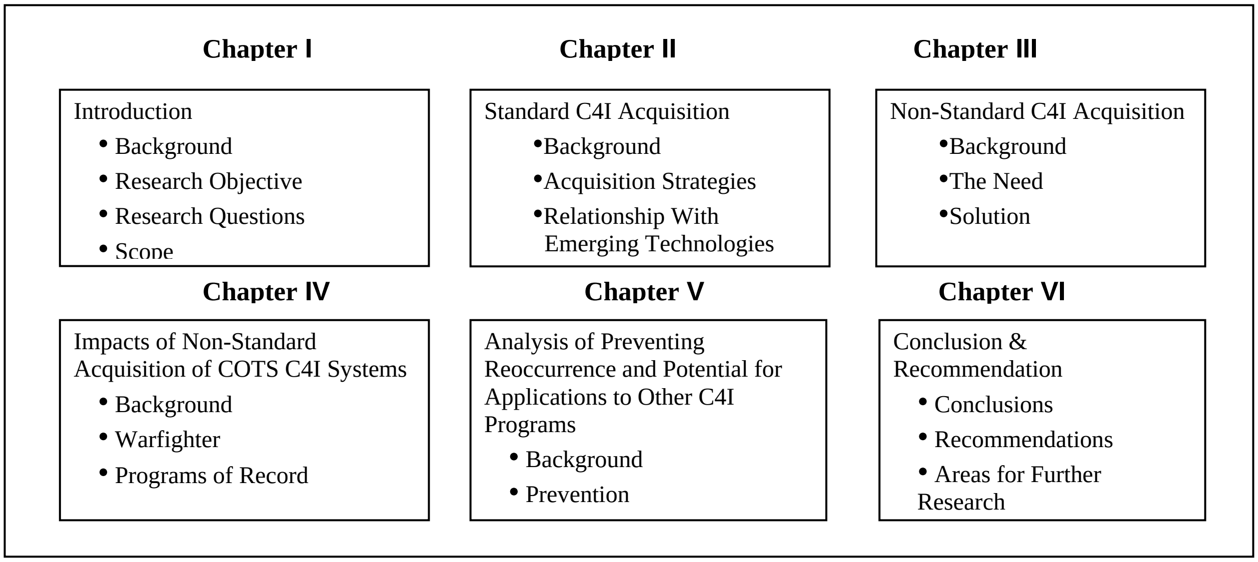

Figure 1. Thesis organization

G. BENEFITS OF RESEARCH

This thesis will provide C4I system engineers and program mangers with an understanding of how non-standard C4I acquisition could occur and actions that could help recognize and mitigate improper acquisition while concurrently incorporating COTS systems into their acquisition strategy.

II. STANDARD C4I SYSTEM ACQUISITION

A. BACKGROUND

In order to maintain our fighting forces and update their warfighting capabilities, the DoD is constantly fielding new systems and capabilities. Bringing these new systems and capabilities to the warfighter is the responsibility of the DoD Acquisition force. Webster's Third New International Dictionary defines acquisition "to come to have as a new or added characteristic, trait, or ability (Webster, 2002)." That is a rather terse definition for an extremely complex process.

In order to appreciate the unique aspects of C4I system acquisition one must first understand the fundamentals of DoD acquisition. DoD Directive 5000.1 defines the Defense Acquisition System as "the management process by which the Department of Defense provides effective, affordable, and timely systems to the users (DoD, 2003)." DoD Instruction 5000.2 "establishes a simplified and flexible management framework for translating mission needs and technology opportunities, based on approved mission needs and requirements, into stable, affordable, and well-managed acquisition programs that include weapon systems and automated information systems (AISs) (DoD, 2003)." The Defense Acquisition Guidebook adds substantively to the definition stating "the Defense Acquisition System exists to manage the Nation's investments in technologies, programs, and product support necessary to achieve the National Security Strategy and support the United States Armed Forces (DAG, 2004)." Examination of the three previous statements illustrates the complex and intertwined relationships among technology, products and cost involved in DoD acquisition. To deal with these complexities DoD developed a decision support system for acquiring materiel and services.

DoD's integrated decision support system is comprised of three inter-related decision-making systems/process: the previously mentioned Defense Acquisition System, the Planning, Programming, Budgeting and Execution (PPBE) process, and the Joint Capabilities Integration and Development System (JCIDS). The three systems represent three different stakeholders: the Defense Acquisition System – Milestone Decision Authority, PPBE – Deputy Secretary of Defense, and JCIDS – Vice Chairman of Joint

Chiefs of Staff/Joint Requirements Oversight Council ensuring their respective priorities are satisfied. Figure 2 illustrates the overlapping nature or 'union' of requirements of the three systems.

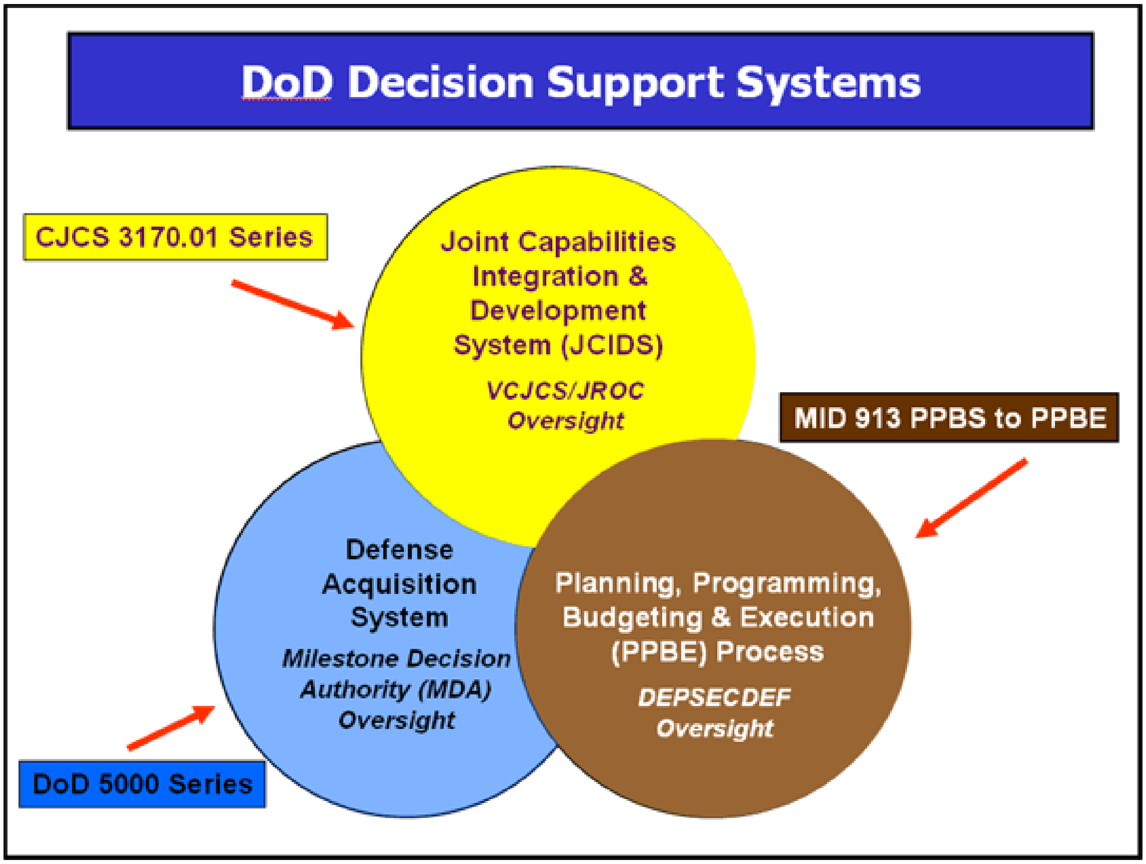

Figure 2. DoD Decision Support System (From DAG, 2004)

1. Defense Acquisition System

The Defense Acquisition System (DAS) is the management process by which DoD acquires weapon systems and automated information systems (AIS). The DoD 5000 series defines the DAS; DoD Directive 5000.1 provides the policies and principles that govern the defense acquisition system and DoD Instruction 5000.2 establishes the management framework that implements these policies and principles.

The DAS management framework provides an event-based process where acquisition programs precede through a series of milestones associated with significant

program phases (DAG, 2004). In essence the DAS evaluates JCIDS defined capability gaps, and initiates and executes acquisition and procurement programs to field systems to bridge these gaps. The DAS process divides the project lifecycle into three general stages: pre-systems acquisition, systems acquisition, and sustainment. These three stages are further divided into five distinct sub-phases: Concept Refinement (CR), Technology Development (TD), System Development and Demonstration (SDD), Production and Deployment (P&D), and Operations and Support (O&S). Figure 3 illustrates the Defense Acquisition Management Framework.

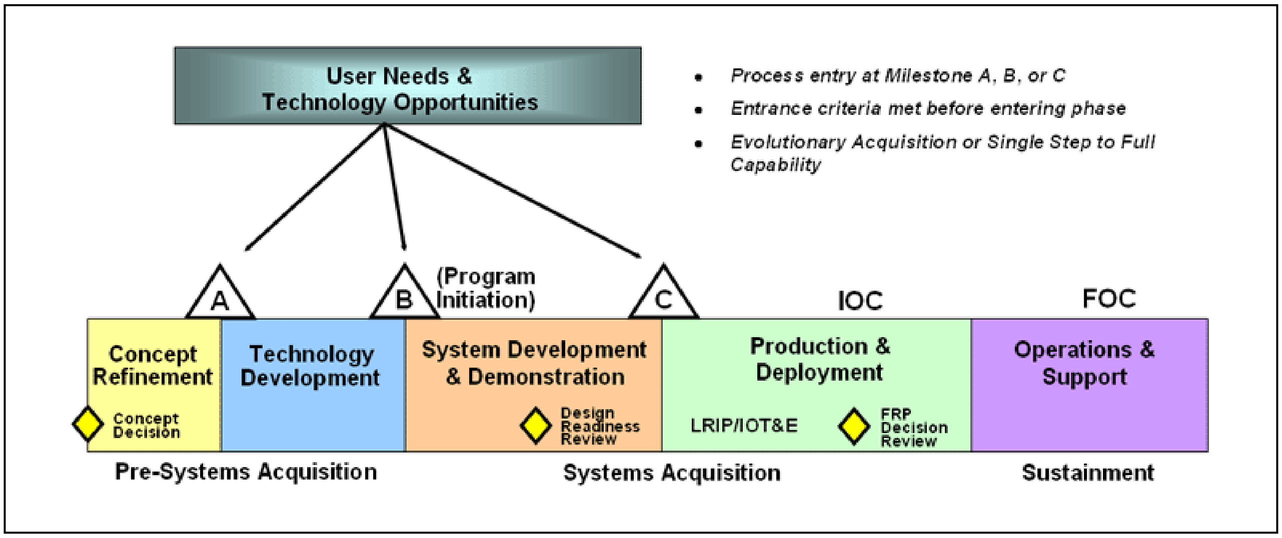

Figure 3. Defense Acquisition Management Framework (From DoD 5000.2, 2003)

2. Planning, Programming, Budgeting and Execution Process

The Planning, Programming, Budgeting and Execution (PPBE) process allocates resources within DoD to meet the requirements of National Security Strategy while providing a vehicle for decision makers to examine and analyze decisions by taking into consideration influencing environmental factors such as threats, political and economic climates, technological developments, and resource availability (DAG, 2004). The goal of the PPBE process is to ensure the DoD acquisition system provides the warfighter the optimum mix of forces, equipment, and support attainable within fiscal constraints in

support of the national security strategy of the US (OSD, 2007). The PPBE process is made up of four overlapping and concurrent phases; Planning, Programming, Budgeting and Execution, and is illustrated in Figure 4.

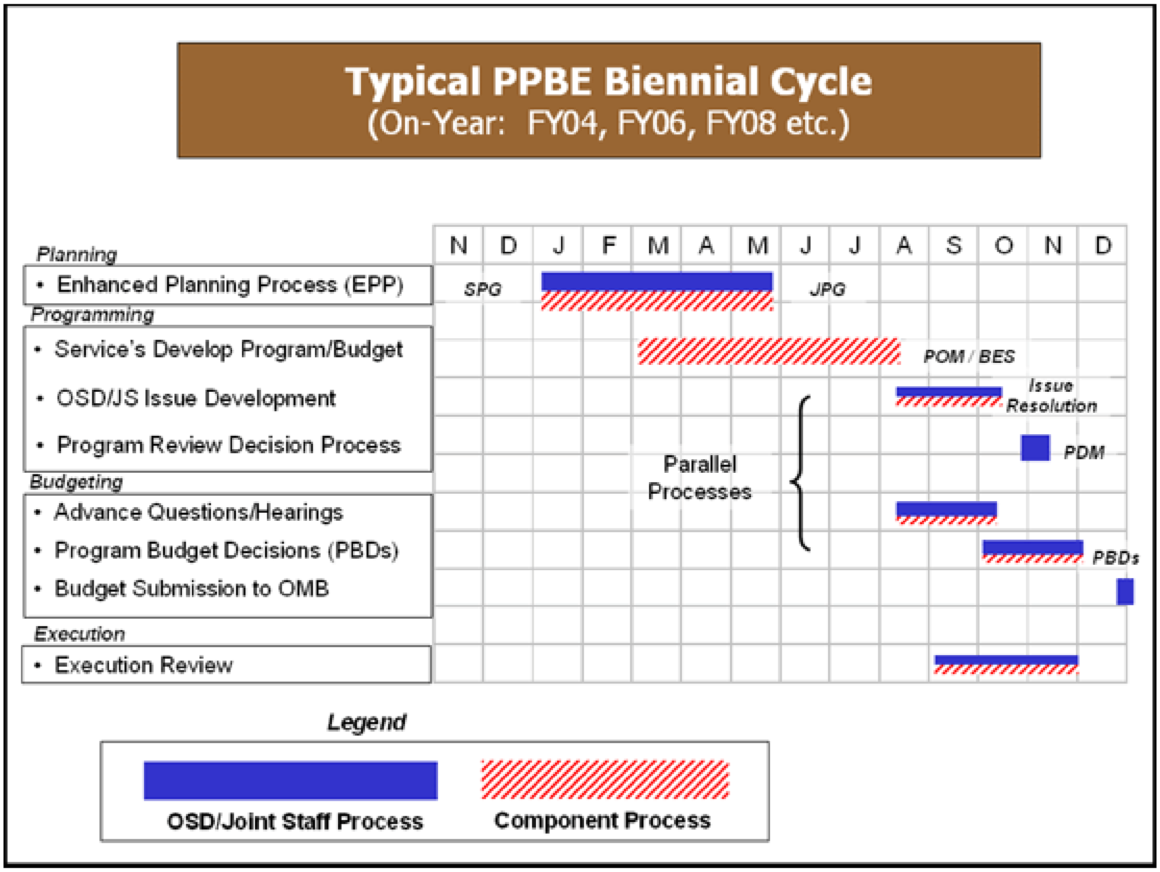

Figure 4. Typical PPBE Biennial Cycle (From DAG, 2004)

a. Planning

The planning phase is the start of the PPBE process. During this phase the Office of the Secretary of Defense (OSD) discusses planning issues with the Joint Staff. The product of this interaction is the Strategic Planning Guidance (SPG) which is based on national defense policies and military strategy. The process follows the SPG to produce the Joint Programming Guidance (JPG): a fiscally constrained guidance and priorities for military forces, modernization, readiness and sustainability, and supporting business processes and infrastructure activities. The JPG is the link between the planning

phase and the follow-on programming phase, and provides guidance to the military departments and defense agencies for the development of their program proposal - the Program Objective Memorandum (POM) (DAG, 2004).

b. Programming

The programming phase is where the programs and budgets start their interaction. The goal of this interaction is to achieve a balance between meeting the JPG priorities and adhering to the fiscal parameters. The programming phase produces the POM – a detailed and comprehensive description, by each DoD component, of the proposed programs, including a time-phased allocation of resources (forces, funding, and manpower) by program projected six-year into the future (DAG, 2004). It is also during this phase where DoD components identify important programs not fully funded (or not funded at all) in the POM, and assess the risks associated with those shortfalls.

c. Budgeting

The budgeting phase is an integral part of the POM process and as such is executed at the same time as the programming phase. This phase translates DoD programmatics into the format of Congressional appropriations. Whereas the programming phase looks at six year time slices, the budgeting phase projects resources for only two years into the future. The shorter timeframe results in significantly more financial details than the associated POM. The budget is reviewed by the offices of the Under Secretary of Defense (Comptroller) and the Office of Management and Budget (OMB) to ensure that programs are funded in accordance with current financial policies and properly and reasonably priced (DAG, 2004).

d. Execution

The execution phase is a review of the accuracy of the current and prior (two years) resource allocation effectiveness to apprise senior leadership decision-makers. To the extent performance goals of an existing program are not being met, the execution review may lead to recommendations to adjust resources and/or restructure programs to achieve desired performance goals (DAG, 2004).

3. Joint Capabilities Integration and Development System

Current and future military challenges will require action by joint forces. Fielding the proper weapon system and capabilities requires funding and coordination across services and agencies. Unlike the bottom-up approach of its predecessor, the Requirement Generation System (RGS), the Joint Capabilities Integration and Development System (JCIDS) is a top-down driven analysis of Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) capabilities and deficiencies conducted in an integrated, collaborative process (Jones and McCaffery, 2005). The JCIDS is a joint concepts-centric, capabilities identification process that helps joint forces meet future military challenges (CJCS, 2005).

Chairman of Joint Chief of Staff Instruction CJCSI 3170.01E defines the JCIDS process policy and procedures (CJCS, 2005). The JCIDS provides coordination across the services by assisting the Joint Chiefs of Staff in assessing gaps in military joint warfighting capabilities and recommending solutions to resolve these gaps. These solutions serve as the basis for acquisition analysis programs providing a prioritized and logically-sequenced delivery of capabilities to the warfighters, despite multiple sponsors and materiel developers (DAG, 20047). Figure 5 illustrates the JCIDS top-down capability need identification process.

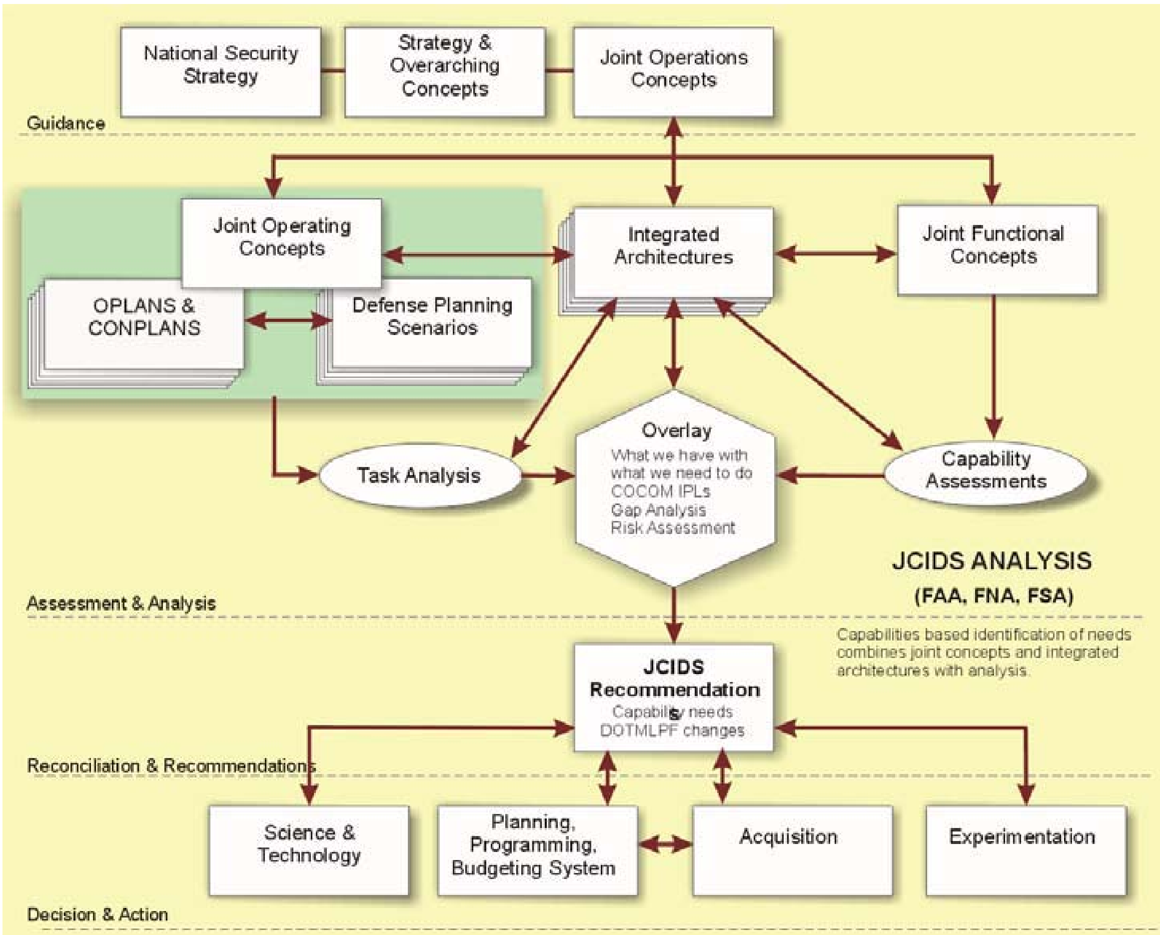

Figure 5. JCIDS top-down capability need identification process (From SMC, 2005)

Figure 6 illustrates the relationship between the JCIDS process and key acquisition decision points.

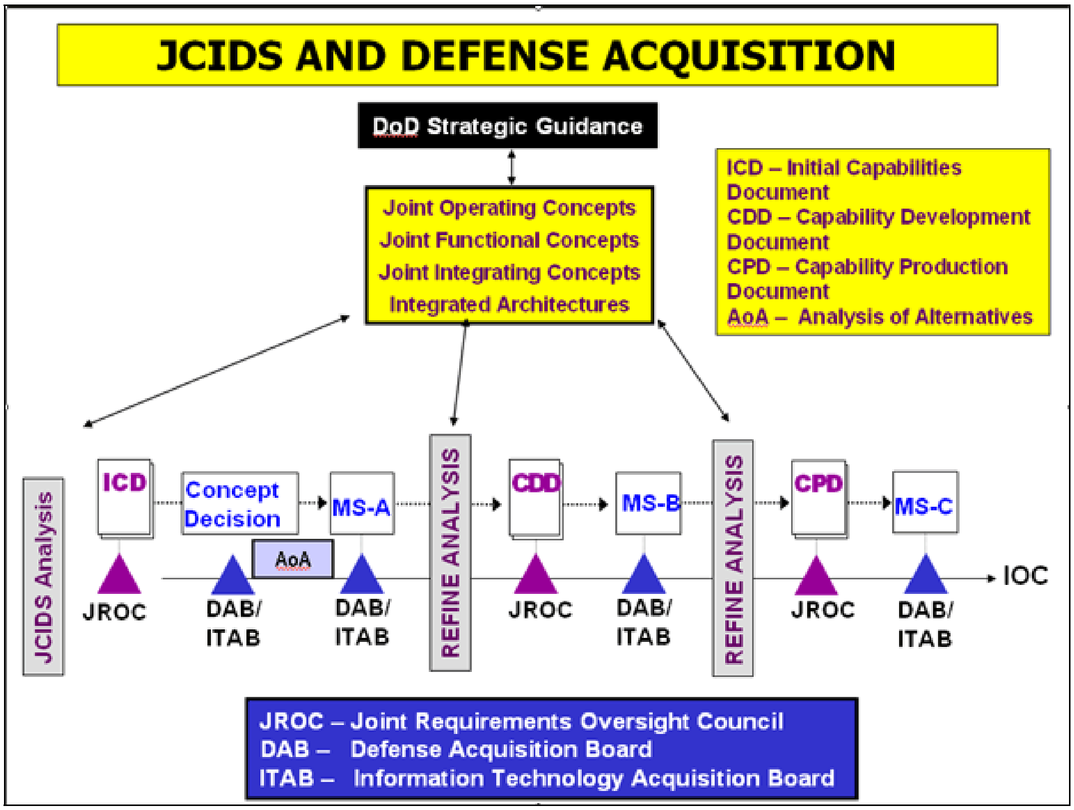

Figure 6. JCIDS process and acquisition decisions (After SMC, 2005)

The preceding discussion is a brief overview of the complicated process by which DoD acquisition program requirements are generated, prioritized, and funded. The following section describes the two DoD acquisition strategies.

B. ACQUISITION STRATEGIES

Providing the warfighter the right equipment at the right time has been a challenge for military acquisition since the day the first tree branch was fashioned into a spear. The challenge has not diminished with time. In spite of advances in production, design and manufacturing, the complexity of capabilities, particularly C4I, required by the warfighter are such that the time to field a specific capability (acquisition response

time) is taking longer than the rate of technology growth. Figure 7 elucidates the impact of technological complexity on time-to-field – acquisition response time.

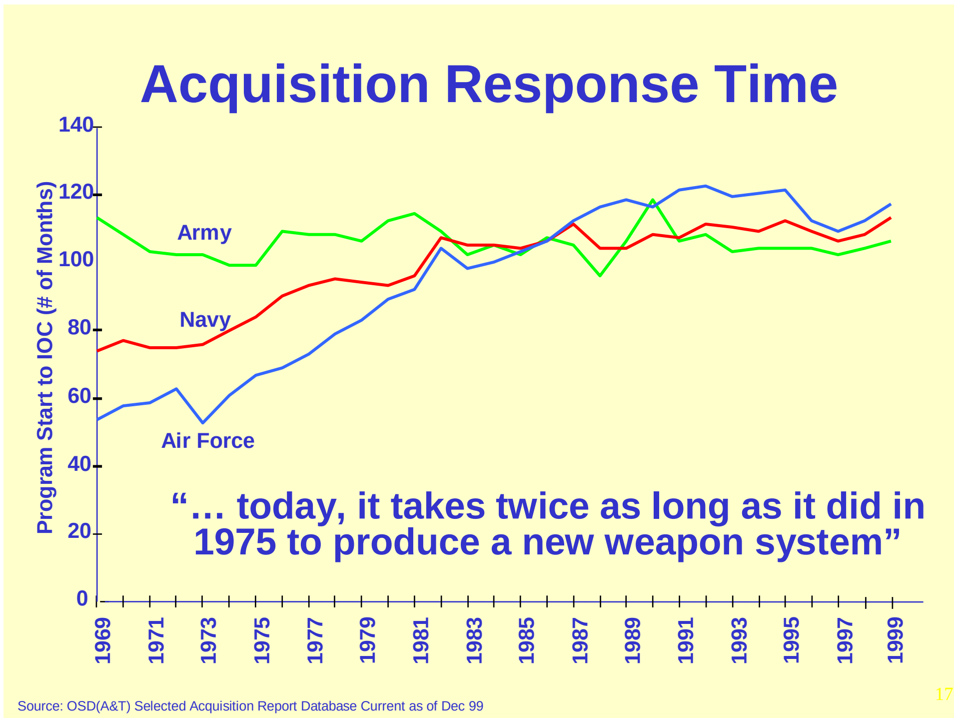

Figure 7. Acquisition Response Time (From Farkas and Thurston, 2002)

DOD 5000.2 lists two acquisition strategies for acquiring new weapon systems: single-step and evolutionary acquisition. The strategy used depends upon urgency of requirements, maturity of key technologies, and cost and benefit analysis between single-step and evolutionary.

1. Single-step

Single-step acquisition is commonly referred to as 'traditional acquisition' where a new capability is delivered in a single-step irrespective of the design challenges or technical maturity necessary, and only after all requirement thresholds have been met. Figure 8 illustrates the single-step approach.

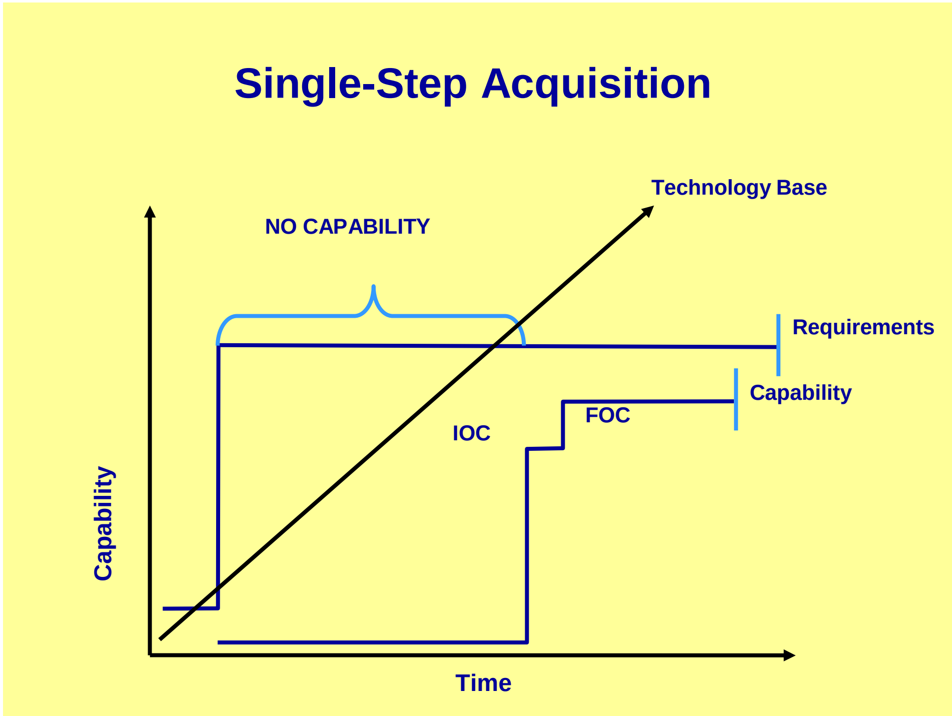

Figure 8. Single-Step Acquisition (From Burns, 2003)

A single-step acquisition program normally includes a variety of technologies (low-risk and high-risk) in order to achieve the weapon systems' full capability. This requires managing certain high-risk technology items, resulting in longer development timelines and the added likelihood of schedule slips (Burns, 2003). Historical averages for single-step program fielding are on the order of 11-15 years (GAO, 2002). These long development cycles often resulted in the fielding of a technologically-obsolete system. With very few exceptions (e.g., new ship construction), single-step acquisition strategy does not satisfy the war fighters' acquisition time line.

2. Evolutionary Acquisition

DoD acquisition has been transforming for the past 25 years. However, the turning of the 21st century has brought about some of the more significant changes in how DoD acquisition meets warfighter needs. In late 2002, Deputy Secretary of Defense Paul Wolfowitz canceled the existing set of DOD 5000 series acquisition regulations because

they were "not being flexible, creative or efficient enough to meet the needs of the DOD (Jones and McCaffery, 2005)." Secretary Wolfowitz ordered a revision of the acquisition process and a reissue of the directives to, “rapidly deliver affordable, sustainable capability to the warfighter that meets the warfighter’s needs (Jones and McCaffery, 2005)." His sentiments echoed those of Mr. Aldridge, USD AT&L, who in October of 2001 lauded evolutionary acquisition as "the means to get new capabilities to the warfighter even faster, field new systems with some but not all of the their ultimate features and adding new technologies in block upgrades as they become available (Frakas and Thurston, 2002)." Figure 9 is a simplified illustration of evolutionary acquisition.

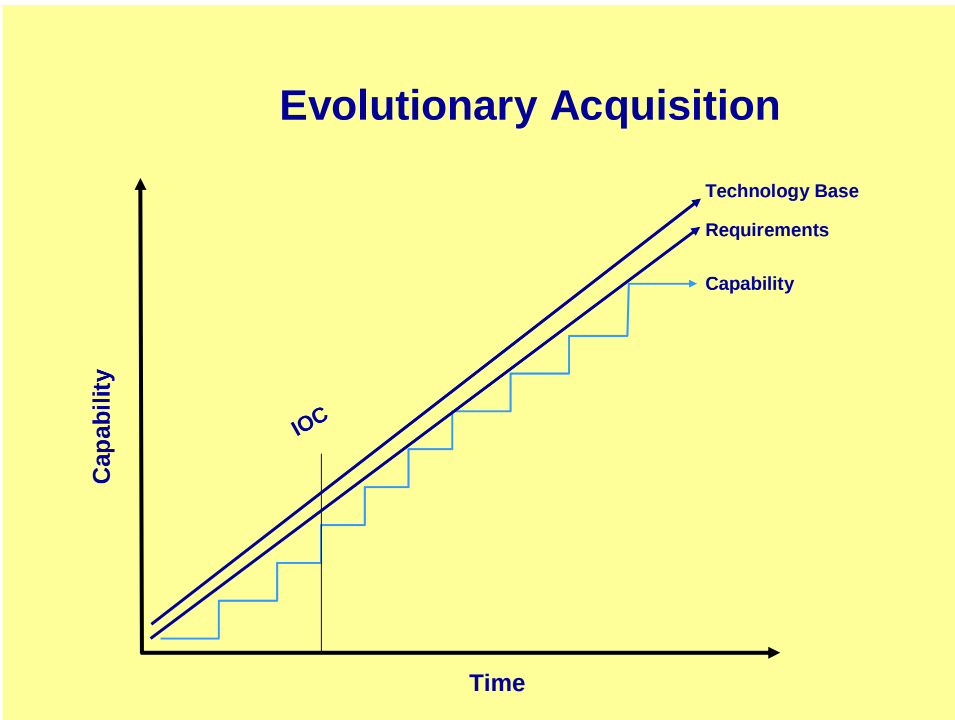

Figure 9. Evolutionary Acquisition (From Burns, 2003)

Secretary Wolfowitz issued new guidance, the result of which was the adoption, per DoD 5000.2, of the evolutionary acquisition (EA) strategy as the preferred DoD acquisition strategy.

> Evolutionary acquisition is the preferred DoD strategy for rapid acquisition of mature technology for the user. An evolutionary approach delivers capability in increments, recognizing, up-front, the need for future capability improvements. The objective is to balance needs and available capability with resources, and to put capability into the hands of the user quickly. The success of the strategy depends on consistent and continuous definition of requirements, and the maturation of technologies that lead to disciplined development and production of systems that provide increasing capability towards a materiel concept (5000.2, 2003).

Communication is vital to successful evolutionary acquisition strategy. Collaboration between user, developer, and tester ensures the right capability gets fielded. Two processes support the evolutionary acquisition strategy: incremental and spiral development.

a. Incremental Development

DoD 5000.2 defines incremental development as a process used when a "desired capability is identified, an end-state requirement is known, and that requirement is met over time by developing several increments, each dependent on available mature technology (2003)." Unlike single-step acquisition where a capability is fielded only after all requirements have been met, incremental development allows the fielding of capabilities in blocks (increments) as they become available. It is easy to visualize each increment as a single-step acquisition. Because each increment delivers a specific set of capabilities, it must be managed as a unique acquisition having approved operational requirements, an interoperability key performance parameter (KPP), performance, cost, and schedule goals, testing, and compliance with acquisition oversight requirements as illustrated in Figure 10.

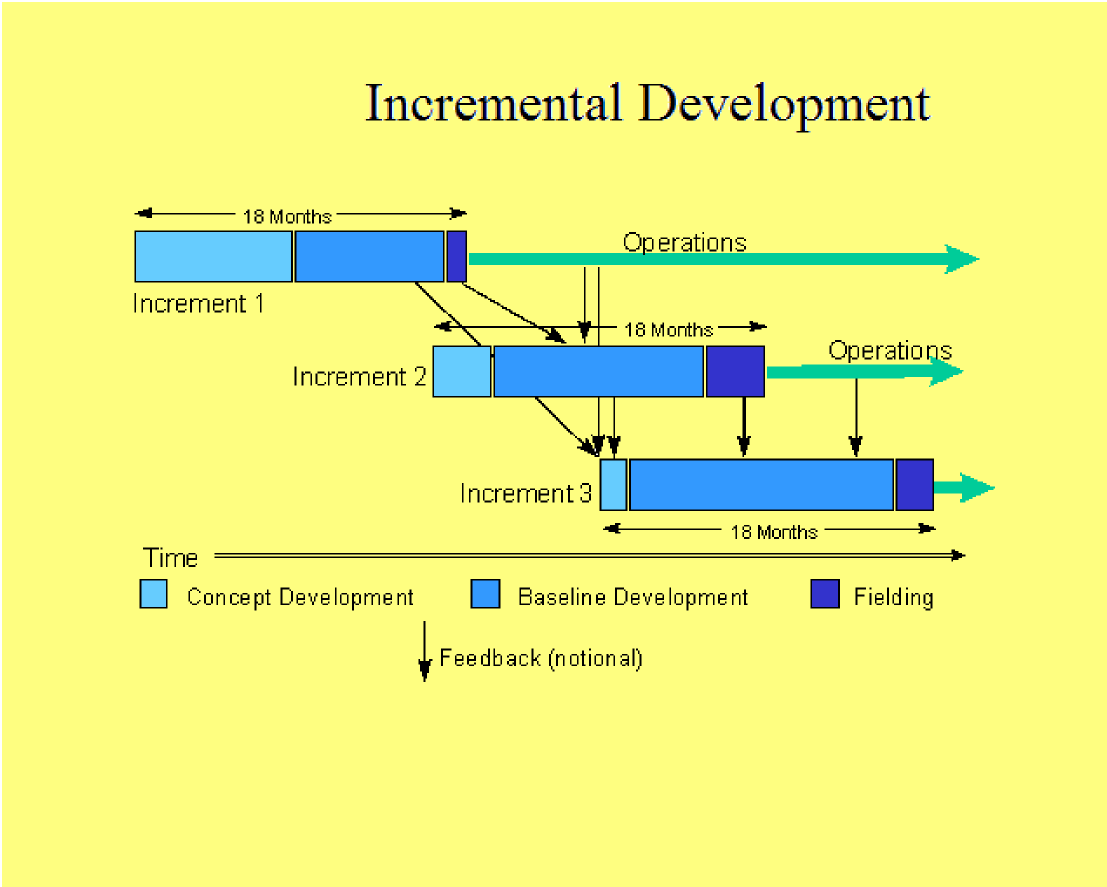

Figure 10. Incremental Development Time Line (From Burns, 2003)

b. Spiral Development

Spiral development is the iterative process by which a capability is developed or matured within an increment. Typically the "desired capability is identified, but end-state requirements are not known at program initiation. Requirements for future increments are dependent upon technology maturation and user feedback from the preceding increment (DoD 5000.2, 2003). The iterative nature of spirals provides a continuous feedback within the increment ensuring that the desired capability is fielded. Figure 11 illustrates the Spiral development process.

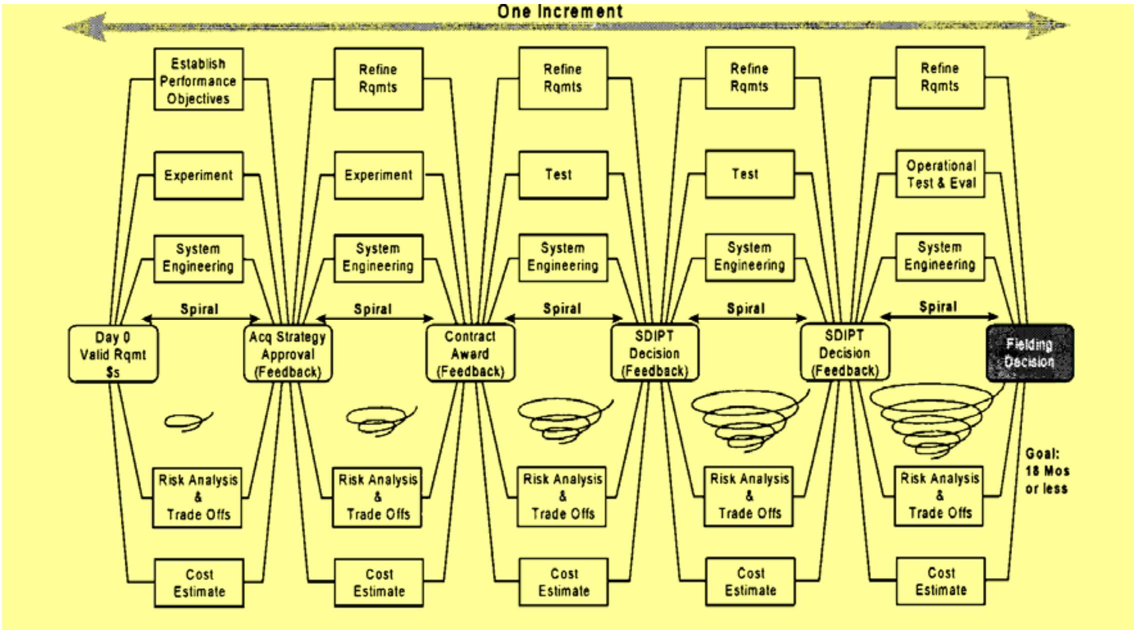

Figure 11. Spiral Development Process (From Burns, 2003)

Acquisition reform brought improvement to the requirements generation process and capability fielding. Figure 12 illustrates the relationship between the JCIDS requirements generation and evolutionary acquisition.

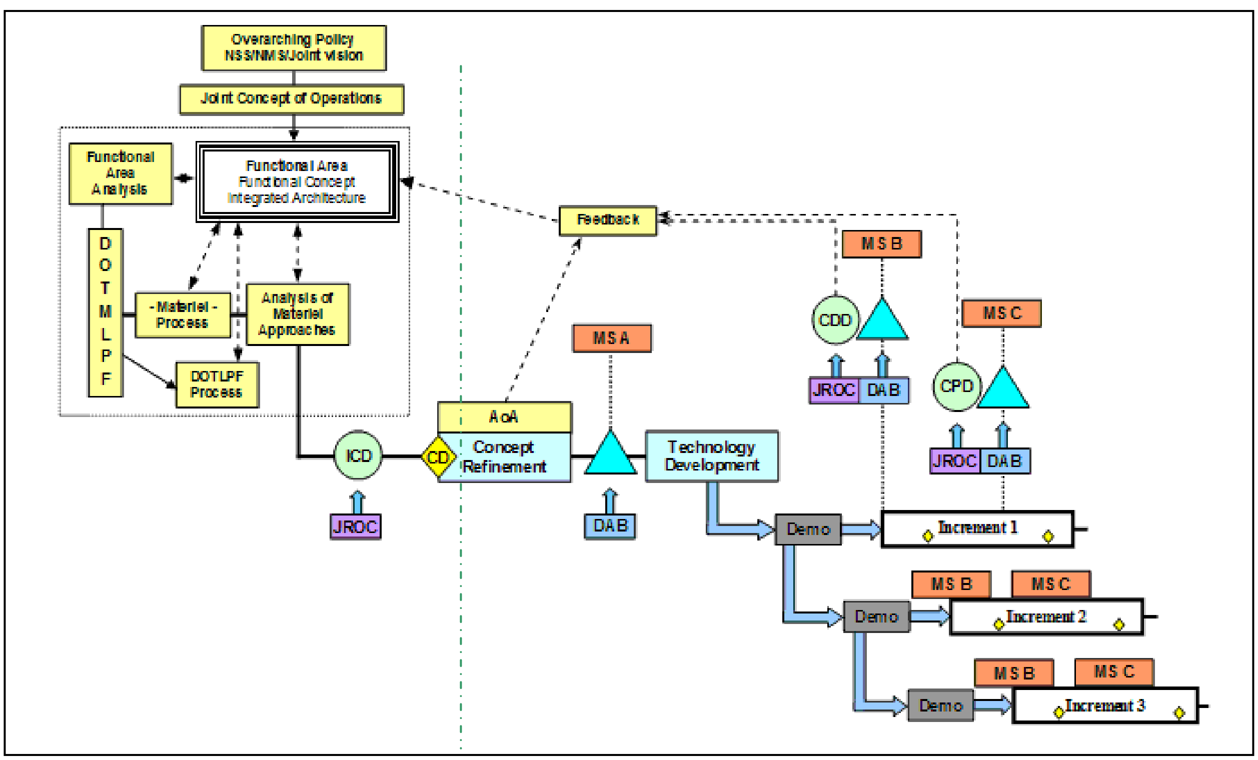

Figure 12. JCIDS Requirements and Process Depiction (From 5000.2, 2003)

C. RELATIONSHIP WITH EMERGING TECHNOLOGIES

Time-to-fielding has been the biggest hindrance to acquisition reform. The preceding section described the requirements and challenges that influence the current DoD acquisition process. Despite the continuing efforts to reform and improve the time-to-field the warfighters are not getting what they need when they need it (Sylvester and Ferrara, 2003). This situation is most prevalent in the fielding of emerging technologies, particularly in the area of C4I systems.

Transitioning emerging technology to an acquisition programs is difficult (Farr, Johnson and Birmingham, 2005). In an effort to field technology sooner the DoD has numerous programs to determine if an emerging technology is mature enough and militarily useful for DoD acquisition programs. Though not all inclusive, the following programs are of particular interest to this thesis.

1. Advance Technology Demonstrations

Advanced Technology Demonstrations (ATD) are conducted to determine if a proposed technology is mature enough to be considered for use by DoD. ATDs bring together interested stakeholders from the, industry, and the science and technology and the research and development fields. The subsequent collaboration helps weed-out unsuited or unattainable technologies, thereby focusing on potential candidates and is illustrated in Figure 13. ATDs are conducted at the Service and DoD agency level using internal funding (DAU, 2005).

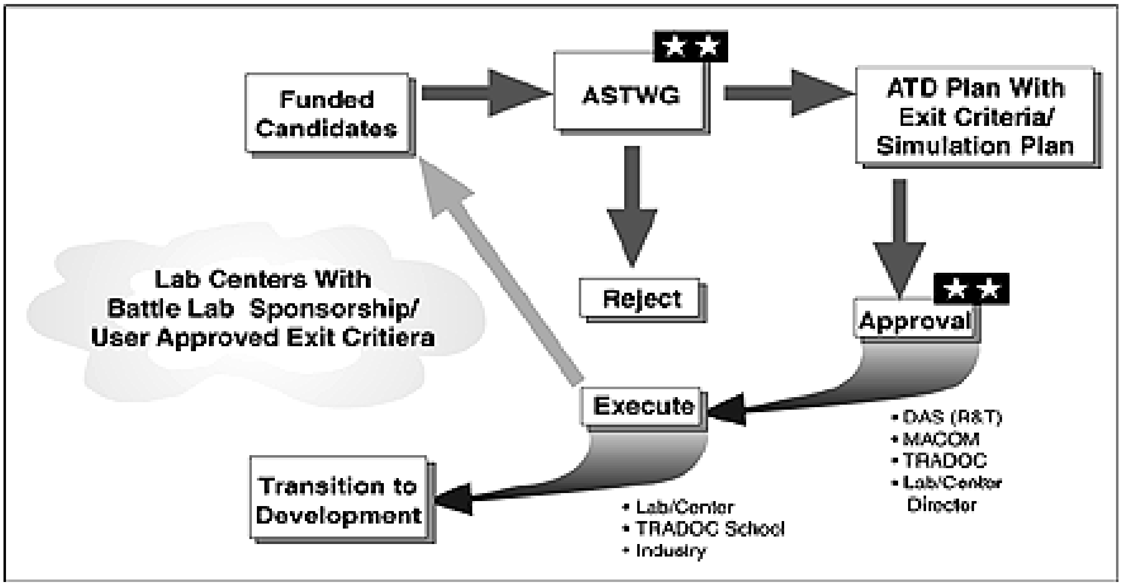

Figure 13. Advance Technology Demonstration Process (From ASTMP, 1997)

2. Future Naval Capabilities

The Navy does not have ATDs *per se* but rather Future Naval Capabilities (FNC) which are essentially equivalent. "The FNC program is composed of Enabling Capabilities (ECs) which develop and deliver quantifiable products in response to validated requirements for insertion into acquisition programs of record after meeting agreed upon exit criteria within five years (Blumenthal, 2007)." The enabling concepts are aligned along the four pillars of Naval Power 21 that were discussed in chapter one. FNCs bring the science and technology (S&T) community into a partnership with the fleet and acquisition community to focus upon transitioning technology to the warfighter.

3. Advanced Concept Technology Demonstrations

The Advanced Concept Technology Demonstrations (ACTD) program is an extension of sorts of the ATD program. Whereas the ATD looks at maturing a technology for DoD use, an ACTD assesses the feasibility of integrating existing technology into DoD programs. The idea being to let actual operators use and evaluated the military utility a prototype capability in an operational, albeit demonstration, environment and is illustrated in Figure 14. Another goal of an ACTD is to help develop

concepts of operations (CONOPS) for the new capability. If the ACTD is successful the demonstrated capability may be 'left in place' for the warfighter to use resulting in greater capability sooner (DAU, 2005).

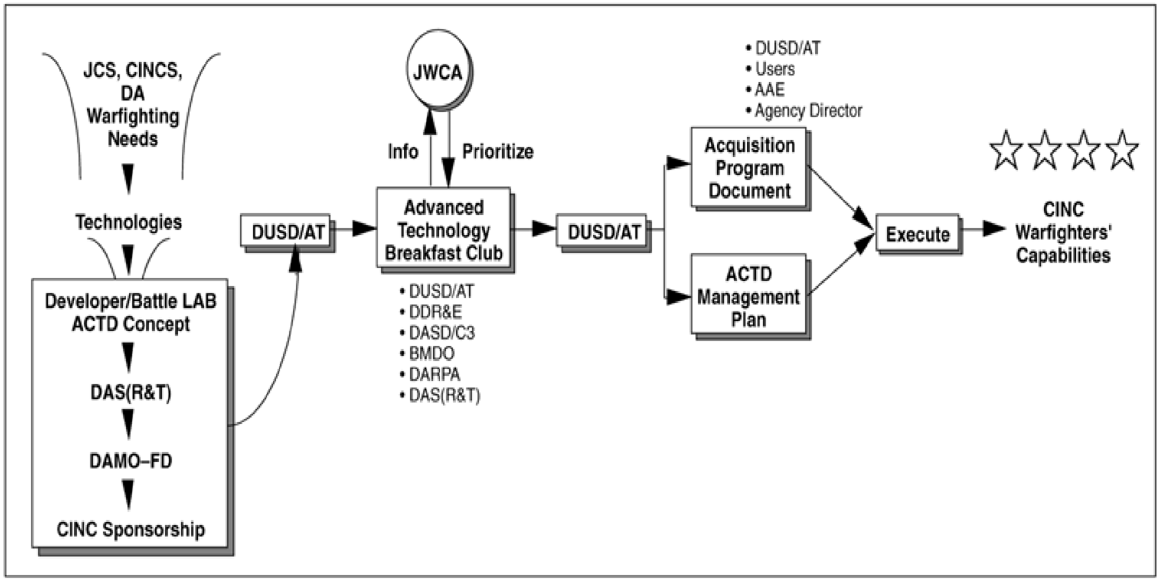

Figure 14. Advanced Capability Technology Demonstrations Selection Process (ASTMP)

In order to keep pace with DoD acquisition reform and the JCIDS requirement process, the ACTD program is in the process of transforming into a joint program - Joint Capability Technology Demonstrations (JCTD). The transformation began in 2006 and is expected to be completed within three-to-five years. The primary goal of this transformation is to give the Combatant Commanders (COCOMs) promising technologies sooner by "rapidly placing relevant, mature technology into the hands of joint and coalition warfighters (Peterson, 2005)."

4. Warfighters Rapid Acquisition Program

The Warfighters Rapid Acquisition Program (WRAP) was established by the Army (and is also used by the Air Force) to shorten the acquisition cycle and be a bridge between experimentation and systems acquisition by addressing the gap in funding that exists because of the time required to plan, program, budget, and receive appropriations

for procuring a new technology (AT&L, 2003). In other words "the WRAP exists to speed proven innovations into official development programs in a fraction of the time that the PPBE process normally takes (AT&L, 2007). The goal of the WRAP is to put new weapons in the hands of soldiers faster and cheaper.

5. Rapid Deployment Capability

The Rapid Deployment Capability (RDC) process is a Navy-specific pre-acquisition effort that enables Navy acquisition to react immediately to a newly-discovered enemy threat(s) or potential enemy threat(s) or to respond to significant and urgent safety situations through special, tailored procedures. If successful, RDCs may transition to Navy Programs of Record (POR) (SECNAV, 2004).

6. Joint Rapid Acquisition Cell

The above mentioned processes and programs have one overarching goal – decrease the time required to field a desired capability. Progress is being made but the Global War on Terror (GWOT) has added a renewed sense of urgency to DoD acquisition. In spite of our best acquisition efforts the COCOMs' find themselves facing an ever-changing and evolving enemy.

When a COCOM has an urgent operational need, which, if left unfilled, would seriously endanger personnel or pose a major threat, which can not be met through normal acquisition process, he issues a Joint Urgent Operational Need (JUON). If the JUON's solution is required immediately (between 120 days and two years), it becomes an Immediate Warfighting Need (IWN) which is then forwarded to the Joint Rapid Acquisition Cell (JRAC) for resolution (Buhrkuhl, 2006). The JRAC is an Office of the Secretary of Defense (OSD) lead effort designed to "break down institutional barriers to timely and effective Warfighting support (DSD, 2004)." The COCOMs drive the JRAC process that monitors, coordinates, and facilitates meeting Combatant Commanders' IWN (Sheehan, 1997).

Maintaining a well equipped and technologically superior fighting force is a daunting task. The DoD acquisition system is the process by which the warfighters needs are articulated, validated resources and procured. Even after 30 years of reform, DoD

acquisition is struggling to keep pace with warfighter requirements. The numerous processes cited above are testimony to the acquisition system desire to provide the warfighter what he needs when he needs it.

In spite of the numerous paths to rapid acquisition, some capabilities are being fielded outside of formal acquisition channels. Although they seem to satisfy an urgent warfighter needs, these ‘non-standard’ acquisitions impact the fielding of current and future Programs of Records (POR).

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III. NON-STANDARD ACQUISITION OF COTS C4I SYSTEMS

A. BACKGROUND

Every major war and armed conflict introduces new tactics and weapons. Some are the results of lessons learned while others the product of industrious minds. The 'guerilla' tactics of the American Revolutionary Army, the German V-1 rockets and the 'smart' bombs of Operation Dessert Storm are examples from a very long list. All of these share a common theme, "Mater artium necessitas" - "necessity is the mother of invention (Artium, 2007)." This phrase takes on monumental significance when attributed to DoD C4I acquisition.

Unlike other acquisition efforts where 'necessity' is normally the impetus to the 'invention,' C4I acquisition is driven equally by necessity and invention. An example of the first would be the need for greater ship speed necessitating development of better propulsion systems. An example of the latter case would be the need for greater communication bandwidth during a time of data throughput technology growth: the two occurring coincidentally and independent of each other. The invention and necessity duality is most prevalent in C4I systems because of the relative 'youth' of the field and the astronomical growth and advances (re: Moore's law) in computing power. And it is these very attributes that make non-standard C4I COTS acquisition so tempting.

Acquisition reform is an iterative process without a definitive end state. Despite 30 years of reform, restructuring, and process and procedural changes, DoD acquisition remains slow to meet warfighter needs. That unto itself is not new, but rather a continuation of the status quo. Warfighters of today sit in their tents, reminiscent of their Civil War predecessors, decrying their leadership for the want of better weapons. There will always be something better, newer, or more capable, particularly in the area C4I technology, but it is unrealistic to expect an apparatus such as DoD acquisition to field such capabilities in near-real-time. Regardless of the urgency or speed of effort, large scale acquisition takes time. It takes time to make sure it is the right capability and that sufficient funds are allocated for procurement. It also takes time to test, evaluate, and field.

In most circumstances, the warfighter understands these realities, but when it comes to fielding C4I capabilities, that understanding quickly disappears. It easy to appreciate the time required to design and build a new armored transport vehicle. The warfighter ‘gets it,’ he understands the material reality. That understanding falls apart when the capability is C4I-related. Unlike armored transports, which are extremely DoD-specific, communication gear, especially the technically-advanced, is seemingly commonplace. It is that commonness, that appearance of ease, which challenges C4I acquisition. It is in cases where that perceived ease is applied to combat needs, that the situation is ripe for non-standard acquisition.

1. Operation Desert Storm

Operation Desert Storm defined the notion of modern warfare. Despite being 6000 miles away, Americans (and the world) watched the war in their living rooms. Technology made that possible. Satellite communication, cable television, and the World Wide Web brought the sights and sounds of near-real-time war into peoples' daily lives (Hallin, 1991).

Technology drove the war. Streaming video from unmanned aerial vehicles (UAV), overhead imagery, and real-time beyond-line-of-sight (BLOS) tactical communication provided commanders unprecedented battlefield intelligence. Laser-guided and precision 'smart bombs' were launch hundreds of miles from their targets, striking feet, if not inches, from their aim point. Operation Desert Storm was a proving ground for the latest technologies and a demonstration of warfighter ingenuity (Hallion, 1991).

Unlike the battle fields of Southeast Asia, the deserts of the Middle East are essentially featureless expanses that make navigation extremely challenging. Although not completely fielded, the Air Force's Global Positioning System (GPS) proved to be the lynch-pin to coordinated maneuver warfare success during Operation Desert Storm. These relatively inexpensive hand-held navigation systems provided the warfighter unprecedented location and navigation information. Commercial GPS units were purchased off-the-shelf by the thousands to outfit tanks and other mechanized vehicles. It was with these hand-held GPS systems that we first saw technology-driven non-standard

acquisition on a large scale: "GPS receivers were attached, in some cases with tape, to vehicles and helicopter instrument panels and were also used in F-16 fighters, KC-135 tankers, and B-52 bombers (Pace, 1995)." Need, affordability, and ease of use allowed the warfighter to literally buy the units off-the-shelf for immediate use.

2. Global War on Terror

The attacks of September 11, 2001, changed the world. The subsequent GWOT redefined the concept of 'war.' The enemy is everywhere and nowhere, state-sponsored and independent, reviled by many and adored by others. Conventional methods and mindsets would have to adapt to the new threat. Unlike the earlier 'desert war,' the GWOT was anything but Desert Storm II.

Where Desert Storm had defined geography and enemy order-of-battle, the GWOT barely has either. Where Desert Storm had planning and preparation, the GWOT was initially a reaction that has become more refined, but still lacks a definitive end-state or clear objectives. Where the US had the clear technological edge over an antiquated, ill-equipped and poorly-led opponent in Desert Storm, today's enemy is using the most advanced technologies available. Numerous joint task forces (JTFs) are expending hundreds of millions of dollars and thousands of man hours to develop tactics and technologies to defeat the enemy threats.

The task of establishing and maintaining tactical superiority over the enemy is the hardest in US combat history. Many factors contribute to that challenge. Benevolent allies, coupled with unprecedented access to information, technology, and readily-available weapons, make it easy for the enemy to field a technologically-advanced and capable fighting force. Countering those threats has put a tremendous strain on the DoD acquisition system and, to its credit, DoD acquisition is making tremendous strides with the unprecedented speed to field systems to counter the emerging threats. The previously-mentioned JRAC process and ACTDs are good examples. Yet in spite of these rapid fielding programs, non-standard C4I acquisition occurs by using the urgencies of the GWOT as rationale.

3. Tactical Data Links

Prior to his squadron engaging the French off the Cape of Trafalgar, Admiral Nelson's captains knew his campaign strategy. Anticipating communication (visual and aural) would be nearly impossible once action began; Nelson brought his Captains together and briefed his strategy. He made sure his Captains had all relevant information as to how the campaign would be waged - that they had good situational awareness (SA). Situational awareness, or "SA" as the warfighters prefer to say, is critical to mission success. Formally defined, SA is "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future (Endsley, 1996)". In combat-speak SA is 'knowing what's going on around you.'

Due to the evolving complexity of warfare and the capabilities used in its execution, establishing and maintaining SA has become extremely difficult. Briefing a few ship commanding officers as Nelson did, or using semaphore of Nimitz's WWII, or employing the line-of-sight voice nets of Viet Nam, would be insufficient in executing the GWOT. The threat sector is 360 degrees. Timely and accurate tactical information is the SA fuel that feeds the warfighters, allies, and commanders spread across the globe. C4I systems provide the data path, without which actionable SA does not exist. Prominent among these systems are tactical data links (TDLs).

TDLs provide the bridge or pathway for equipped units to exchange tactical information. TDLs allow participating units to share tactical information such as their own position, location of friendly forces, enemy positions, threats and warnings, command and control instructions, and force orders (to name a few) in real-time. The synergy from this information exchange ensures that each participant, including higher headquarters and command elements, share a common tactical operational picture (CTOP) which translates into efficient and coordinated use of forces.

Link 16 is the DoD's primary TDL. Link 16 is a time division multiple access (TDMA)-based, secure, jam-resistant, and high-speed network that operates over-the-air in the UHF spectrum (PEO C4I, 2004). Link 16 data, called messages, are exchanged via line-of-sight or beyond line-of-sight using Link 16-equipped airborne relays or satellites.

Link 16 messages are exchanged among a group of participating units known as networks. Depending upon the geographical layout and distribution of forces, a given Area of Responsibility (AOR) may have multiple Link 16 networks running concurrently. Figure 15 illustrates the data exchange of a typical Link 16 TDL network.

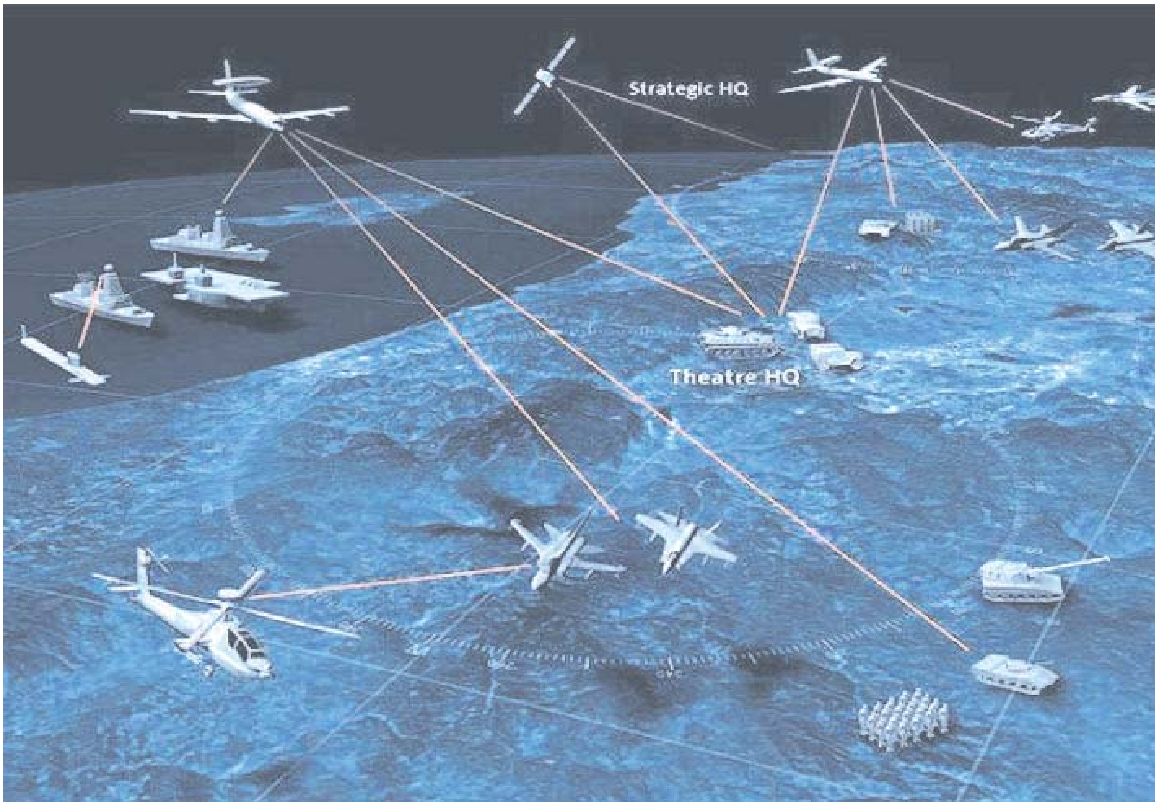

Figure 15. Typical Link 16 Network (From PEO C4I, 2004)

B. THE NEED

Fielding a new capability is a challenge and fielding a C4I capability even more so. Due to comparatively lengthy fielding time, when compared to the rate of technology growth, it is difficult to field a technologically-current C4I capability - even using spiral acquisition. As difficult, if not more so, is bringing a new capability, as either a technology refreshment or an entirely new capability, to a deployed ship.

The GWOT communication demands are tremendous, particularly in the field of data links. These unprecedented demands are the product of an increase in the number of

TDL-capable platforms and information exchange requirements (IER). In other words, more information is available and more people want access to it.

Prior to 11 September 2001, a deployed Battle Group's (BG) primary focus was satisfying its (AOR) commander. For the Pacific Fleet, this responsibility started with Commander Third Fleet (C3F) and shifted across the pacific as the BG moved westward to Commander Seventh Fleet (C7F) and finally to Commander Fifth Fleet (C5F) in the Persian Gulf AOR. However, unlike in the past, where TDL data dissemination was limited to a particular battle group in one AOR, today's information demands are such that TDL data is propagated around the globe 24/7. The battle-rhythm calls for real-time information to be available to decision makers throughout the chain of command across multiple AORs.

The GWOT also changed how battle groups deploy. Prior to 9/11, ships in a battle group operated in close proximity to each other, normally within line-of-sight. Today, a battle group's ships are spread across an entire AOR, hundreds of miles from each other, well beyond line-of-sight of each other. The consequences of the new deployment scheme significantly impacted TDL communications. Although sufficient for pre-9/11 operations, existing capabilities could not support the increase in Link 16 message traffic volume. Many ships, particularly large deck and command ships, were not equipped to handle the new TDL demands. Ships that formerly received their Link-16 via line-of-sight were suddenly operating well beyond line-of-sight without any means to receive Link 16 messages.

Requests for assistance started pouring in with the commencement of Operation Enduring Freedom (OEF). The suddenness of the campaign found deployed units unable to meet the new Link 16 demands. The Link 16 communication demands varied depending upon a ship's mission and existing TDL capability configuration. The new TDL requirements fell into two categories: add beyond line-of-sight Link 16 capability and remotely display Link 16 information for the Battle Group staff.

1. Add Beyond Line-of-Sight Capability

Navy ships are mission-specific; so follows their design. Aircraft carriers do not have shore bombardment guns because that is not their mission. Every system and capability on the ship was designed to support air wing operations. That specificity of purpose is mirrored in how ships are deployed in battle groups. A typical battle group is built around a high value unit (HVU), a command ship or aircraft carrier, with the supporting ships distributed to optimize their individual capabilities while collectively providing the best defense for the HVU. A battle group presents a formidable fighting force by combining an optimized set of mission-specific ships.

The GWOT changed how the Navy deploys its ships. In the past battle groups deployed to specific AORs for specific durations - almost like clockwork. Today, Navy ships are needed everywhere, all the time. There is no such thing as a 'standard' six-month deployment. Ships are deploying in smaller Carrier Strike Groups (CSG) or Expeditionary Strike Groups (ESG). As ingenious as these deployment strategies are at meeting the increased demand for naval presence, without a corresponding increase in number of ships, they have created significant C4I capability gaps. One of the more significant gaps is beyond line-of-sight Link 16 communications.

In a traditional aircraft carrier battle group (CVBG) the beyond line-of-sight Link 16 capability resided in cruisers and destroyers which were equipped with UHF satellite Link 16 known as Satellite TDL J or STJ. CVBG deployments were such that it was not necessary for every guided missile cruiser (CG) or guided missile destroyer (DDG) in the battle group to have STJ. There were enough STJ ships to support the deploying CVBGs. However, that is not the case with CSGs or ESGs. There simply are not sufficient numbers of STJ-equipped CGs or DDGs to support every CSG and ESG. Command ships found themselves operating beyond line-of-sight from their beyond line-of-sight Link 16 equipped supporting ships.

2. Remotely Display Link 16 Information

The Navy is in the process of designing its new generation warships. Until those ships are deployed, the Navy will continue fighting the twenty-first century GWOT with

ships built for the twentieth century, blue-water cold war: ships and battle groups designed to take the battle to our enemy's oceans by firing cruise missile and launching aircraft from hundreds of miles away. Aircraft carriers' combat systems were designed for those long-range battles where aircraft and missiles strike their targets hours after they are launched and enemy attacks are detected hours in advance. Under those circumstances, the Admiral and his staff did not need real-time data, updated to the millisecond, displayed in his Task Force Combat Center (TFCC). That level of information was more appropriate and necessary for the ship's force so that they could "fight the ship" and was displayed in the ship's combat information center (CIC).

Today's Navy sits on the enemy's doorstep. Attacks are minutes rather than hours away. Real-time tactical information is vital to the Admiral and his staff. Whereas in the past the Admiral might have one of his staffers walk the 20 minutes to CIC to get an update – that time is a luxury he no longer enjoys. He needs to 'see' the tactical picture. He needs the most current tactical information displayed on his watch floor - TFCC. He needs it so that his SA is the best it can be.

C. SOLUTION

The first step in solving a problem is identifying the problem. Ships at sea had what they deployed with when Operation Enduring Freedom (OEF) began. Gradually, the tactical data link deficiencies came to light; existing Link 16 networks were not sufficient to meet the war-driven demands, data was not moving fast enough for the decision-makers. Lacking the resources and ability to correct these deficiencies, the Fleet articulated their needs up their chain of command (CINCPACFLT, 2002). In accordance with DoD policies and regulations, they requested assistance from Commander, Fleet Forces Command (CFFC), their advocate for fleet personnel, training, requirements, maintenance, and operational issues (CFFC, 2007). The request was forward to the Navy's tactical data link acquisition program office at the Space and Naval Warfare Command (SPAWAR), Program Management Warfare 150 (PMW 150), for Link 16 assistance (COMSPAWARSYSCOM, 2002).

1. Program Offices and Programs of Record

Acquisition program offices are the technical authorities responsible for the acquisition management of the Programs of Record (POR) that fall under their purview. Upon receiving the request for assistance from CFFC, PMW 150 investigated possible timely solutions that would satisfy the new needs. Two words from the previous sentence warrant discussion: timely and needs.

a. Timely

As with most program offices, PMW 150 had a strategic plan or road map for ensuring its POR would continue to meet their sources sponsor's and ultimately the Fleets' TDL requirements. These roadmaps are typically aligned with the Program Objective Memorandum (POM) cycle. Both of the new Link 16 needs were immediate (weeks or months) with respect to timing whereas the PMW's roadmap dealt with a timeframe on the order of years (Bobrowich, 2003).

b. Needs

DoD acquisition is a formal and deliberate process guided by regulation, e.g., the JCIDS process. The process separates validated requirements from 'wants' and 'needs' and is designed to ensure that the right capabilities are delivered and the resources executed properly. Without this rigor, chaos would quickly ensue. Neither of the new Link 16 needs were validated requirements.

After exhaustive research the program office concluded it did not have a POR that would provide the requested capabilities within the desired time frame (Fredrickson, 2003). Its solution to adding a beyond line-of-sight Link 16 capability was a planned TDL system upgrade that was scheduled to deliver these capabilities in four years. The program office had no plan whatsoever to deliver a remote Link 16 display capability. Furthermore, without validated requirements and specific direction from their resource sponsor, there was nothing the program office could do to further any solutions to meet the specified time frame.

2. Industry

Due to the uniqueness of the capabilities being delivered, DoD acquisition used to be a purely 'military' thing, focused exclusively on acquiring warfighter capabilities such as tanks, rockets, jet bombers, and guns. That remains the case today, but in certain areas DoD capabilities are almost identical to civilian applications. This is most prominent in the area of C4I.

Twenty years ago practically every system on a ship was designed specifically for that ship. The militarily-unique equipment was labeled with generic placards. Walk through any warship today and the radio room and CIC looks like endorsements for an electronics superstore. The majority of all C4I equipment is either built upon or entirely civilian systems. To its credit, DoD acquisition reform recognized the value of using commercial-off-the-shelf technology (COTS) and has mandated COTS consideration as part of the analysis of alternatives (AOA) acquisition phase.

> To achieve the best possible system solution, emphasis shall be placed on innovation and competition. Existing commercial-off-the-shelf (COTS) functionality and solutions drawn from a diversified range of large and small businesses shall be considered (DoD 5000.2, 2003).

While the program office was endeavoring to solve the short-notice Link 16 needs, necessity continued to drive those who initiated the request. That necessity, combined with the industry's eagerness to help, produced a viable, albeit non-standard solution – ADSI (pronounced 'add see').

The Air Defense System Integrator (ADSI) is an Ultra Electronics Company multilink-capable data link processor that satisfied both the beyond line-of-sight Link 16 and the remote display needs. ADSIs are used by the US Air Force and Army units deployed in support of Operations Enduring and Iraqi Freedom. Word-of-mouth among the tactical datalink community brought ADSI to the attention of Navy operators, who seeing this as the only means of obtaining the desired capabilities, acquired units directly from Ultra Electronics.

Fighting the GWOT has put tremendous strain upon the entire DoD acquisition system. Warfighters' request for more and better capabilities forced dramatic changes in the fielding of capabilities, particularly in the area of tactical datalinks, the end result of which was the non-standard acquisition of C4I capabilities. Although the non-standard acquisition satisfied the warfighters' need, its impact on existing and future PORs was significant.

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IV. IMPACTS OF NON-STANDARD ACQUISITION OF COTS C41 SYSTEMS

A. BACKGROUND

The success of the initial ADSIs' installation had a tremendous and immediate impact upon the Navy shipboard TDL community. For less than $120K, a ship could achieve the desired TDL capabilities in an unprecedented time-frame (Ture, 2007). News of the ADSIs' success drew significant attention from the Link 16-deprived large-deck command ships and aircraft carriers. The TDL genie was "out of the bottle."

As the number of ships supporting the GWOT grew, so followed the proliferation of ADSIs. In order to participate in the established AOR communication architecture, incoming battle groups demanded the same capabilities as their successful outgoing predecessors (USS CORONADO, 2003). In less than three years, five ADSIs had been purchased – outside the formal acquisition process and unbeknownst to the TDL program office.

News of operational impact of the few fielded units spread throughout the Navy TDL community. Although the benefits of the having an ADSI were obvious, acquiring one directly from the manufacturer was not an option for all. Some ships lacked the funds to purchase the units, while others thought it the responsibility of Navy acquisition to deliver the needed capabilities. The end results were the same – a new round of requests for assistance was sent up the chain of command.

Unlike the vague request from 18 months prior, these requests were very specific often asking for ADSI by name (COMPACFLT, 2004). Where the earlier request lacked specific justification for the wanted the capabilities, the impact of the fielded ADSIs during the subsequent 18 months made a compelling case for acquiring these capabilities. ADSI had proven itself and requests for the additional units continued to grow.

Over the course of 12 months, the program office received six formal requests for ADSI or ADSI-like capabilities. That number of request over a relatively short period of time highlighted the Link 16 redisplay and BLOS deficiencies being felt across a significant segment of the Fleet. The requests were vetted through the proper channels,

as before, but this time they were validated by CFFC (COMFLTFORCOM, 2004) and forwarded to OPNAV, who in turn directed the program office to develop a strategy to solve the deficiencies (CNO, October 2004).

There is more to fielding new C4I capabilities than the technology. In some respects technology maturation could be considered the easiest part. The difficulties arise due to the complexities associated with fielding new capabilities to a host of different ships, each with their unique set of integration and scheduling challenges, all of which is further complicated by resource constraints (Nguyen, 2006).

The specific capabilities being requested were not beyond the program office's conceptual grasp. They were, in fact, part of a planed evolution or growth of C4I capabilities. The problem, if that is the proper characterization, was a matter of time lines, a question of when the program office planned to field the capabilities. The program office had a roadmap for fielding new capabilities; it was their tactical data link management plan (TDLMP). The requested capabilities were in the TDLMP, programs such as: the Joint Command and Control (JC2), Next Generation Command and Control Processor (NGC2P), Joint Information Control Officer (JICO) Support System (JSS), Global Command and Control System (GCCS), and the Common Link Integration Processor (CLIP). The TDL requirements created by the GWOT communication demands called for the immediate fielding of these capabilities. Unfortunately, the capabilities were not scheduled to be fielded for another four to six years (CNO, May 2004).

The program office, looking outside traditional acquisition, put forward an ingenious proposal; field ADSI as an interim solution to their PORs. OPNAV concurred with the proposal and directed the program office to support the fielding of 30 ADSIs, to be treated as POR but without formal POR status. The development and subsequent execution of the solution significantly impacted both the warfighter and the program office's POR.

B. WARFIGHTER

The impact of the ADSIs' fielding on the warfighter was immediate and very positive. Their installations were not complex, intrusive, time-consuming, or with significant impact upon existing systems. The little training that was required was provided during their installations. In a matter of days, a ship's TDL capabilities were improved exponentially. The TDL information that provided the Admiral's SA eclipsed all previously available data. The warfighter was getting the information that he needed, when he needed it.

C. PROGRAMS OF RECORD

The nature of the ADSIs "programmatic" status was the driving factor with respect to the impact of their fielding and support upon the program office's PORs. OPNAV was very specific in its directions to the program office; "ADSI is not a funded program" but rather a Navy "system" with the program office acting as the "Project Office responsible for the centrally-funded ADSI systems (CNO, October 2004)." Adhering to OPNAV's direction to support 30 unfunded ADSIs resulted in the program office having to take the associated cost "out of hide." In today's austere acquisition budgetary environment there are not much, if any, extra monies. The program office's "hide" was precariously thin due to supporting existing PORs so the burden of supporting the 30 ADSIs did significantly impact the existing PORs.

1. Impact on Existing Programs of Record

Because the ADSIs were merely a Navy "system," the funds required to support them would have to come from the program office's existing PORs (NGC2P, CDLMS and GCCS). The costs to support the fielding of the 30 ADSIs (new installations ~$305K, as well as upgrading previously-fielded systems ~$140K), were not trivial (PMW 150, 2004). Unlike the handful of previously Fleet-installed ADSIs; which were performed without acquisition rigor; life-cycle support, or formal training, the costs to properly upgrade, field, and support the 30 ADSI is estimated to be on the order of ~$15M (PMW 150, 2004). The impact of the reallocation of resources on the POR was significant and immediate.

ESTIMATED ADSI FUNDING REQUIREMENT SUMMARY					
	FY 05	FY 06	FY 07	FY 08	FY 09
# of Upgrades	6	6	0	0	0
# of New Installs*	5	5	6	0	0
Required OMN	~$1,600K	~$2,340K	~$1,900K	~$1,700K	~$1,400K
Required OPN	~$2,365K	~$1,525K	~$1,835K	$0	$0
Total	**~$3,965k**	**~$3,865K**	**~$3,735K**	**~$1,700K**	**~$1,400K**

* Does not included 2 previously-installed units

Table 1. Estimated ADSI funding requirement summary (After PMW 150, 2004).

The reallocation of PORs funds, particularly the Operations and Maintenance Navy (OMN), hindered the program office's ability to perform its primary Fleet support activities: on-site tech assist, user reported software trouble report (TRs) fixes, and help desk/web-site support for the affected POR. Software is a major component of the affected PORs, making technical assists and responding to TRs routine and unavoidable matters of doing business. Each POR has multiple software versions in use throughout the Fleet which require periodic updates and associated on-site tech assists for installation and training. Another unavoidable aspect of the software updates is the resulting new-software-generated TRs. Each TR has to be vetted, validated (not operator error or other explainable reason), and prioritized (1-4, high to low impact) for correction. A reduction in available OMN funds equates to fewer on-site tech assist, fewer TR fixes (limited to Priority 1), and reduced help desk/web-site support for the associated PORs (PMW 150, 2004).

2. Impact on Future Programs of Record

Future PORs were also impacted by the fielding of 30 non-POR ADSIs. Because C4I capabilities, particularly TDLs, field in an evolutionary manner, future capabilities are normally built upon previous or existing systems. Reductions in near-term funding invariably delay development and delivery of future capabilities. The TRs deferred due to lack of funds did not "go away," they needed to be fixed, and barring the highly unlikely receipt of budget plus-ups, the funds to fix the deferred TRs would come from

the program office's budget. As there is no budgetary slop or cushion, the funds are pulled from existing PORs, perpetuating POR funding short-falls, which in turn result in the delayed fielding of needed capabilities.

Unlike the detrimental impact on existing PORs, the impact of the reallocation of funds on future PORs had some beneficial aspects. The attention gained and interest generated in meeting the Fleet's demand for Link 16 redisplay and BLOS capabilities put the importance of TDLs center-stage in OPNAV. Additionally, having the ADSIs fill the capability gap provided time for capability maturation of the PORs scheduled to replace them – JC2, NGC2P and CLIP.

Although beneficial to the warfighter, the non-standard acquisition of C4I system was detrimental to existing PORs because of the reallocation of funds. Due to the non-POR status of the non-standard C4I system, funding to support them was taken from existing formal PORs. Given the detrimental affects of the reallocation, analysis of preventing future occurrences would beneficial.

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V. ANALYSIS OF PREVENTING REOCCURRENCE AND POTENTIAL FOR APPLICATION TO OTHER C4I PROGRAMS

A. BACKGROUND

In spite of volumes of acquisition regulations, instructions, directives and guidance, non-standard acquisition occurred. The preceding chapter summarized the circumstances which precipitated the proliferation and subsequent non-standard acquisition of a COTS C4I system. With an understanding of those circumstances, an analysis of preventing future occurrences would be of interest, particularly with respect to applicability to other C4I programs.

B. PREVENTION

Prevention is not simply a matter of answering the question; "how could this have been prevented?" That is certainly an important question, but there is an equally important question; "was it preventable?" Given the number, size, and cost required to deliver capabilities to the warfighter, DoD acquisition is necessarily very process-oriented, allowing little room for interpretation. Understanding how the processes were followed (or not) as well as the impact of the GWOT on the process, will answer both prevention questions.

1. Process Compliance

The Navy has been successfully deploying its forces for over a century. That success is directly attributable to a well-defined process that ensures sailors have the required capabilities. That process, the defense acquisition system, is the means by which requirements, resources, and delivery of capabilities are managed. Previous chapters defined the numerous participants in and the multiple layers of the requirements generation process. In spite of those requirements, non-standard acquisition still occurred, which begs the question "was the process followed?"

a. Fleet

The GWOT put tremendous TDL demands on deployed ships. Unable to meet these demands, various battle group staffs, following the proper channels and procedures, requested assistance from their chain of command (C7F, CPF to CFFC). Acknowledging the stream of TDL demands and the necessity for the capability, CFFC validated and forwarded the request to the Navy's requirements office, OPNAV N6.

Even though they purchased a few units outside of proper acquisition channels, overall, the Fleet had basically complied with the process.

b. Navy Requirements Office

Upon receiving the CFFC-validated request, the Navy's requirements and resources office, OPNAV, directed the responsible program office, SPAWAR PMW 150, to develop a strategy to meet the validated requirements.

OPNAV had complied with the process.

c. Program Office

By definition, program offices manage PORs that have defined capabilities and schedules. Program Offices are not designed, resourced, or configured to meet short-notice requests. Their only viable course of action in response to OPNAV's direction was to look to their PORs for possible solutions.

The program office had products under development that would eventually provide the requested capabilities; unfortunately their fielding schedules did not support the immediate requirements. The only option for delivering the desired capabilities in the time required was to field a proven system, the ADSI. Accordingly, the program office developed an ADSI fielding strategy using funds from existing PORs.

The ADSI was the only proven system able to meet the fielding schedule. In spite of not being a POR, and at OPNAV's direction, the ADSIs were fielded. The program office had complied with the process.

Starting with the initial request and going up the Navy acquisition chain of command, proper procedures and processes were followed. With the exception of the few individual ships that purchased the units commercially, all parties complied with defense acquisition system guidance.

2. Options

The GWOT added an appropriate sense of urgency to battlefield request. Warfighters were not requesting capabilities because they merely wanted something new; they were engaged in combat and critically needed the capability. The acquisition system responded with an array of programs to help meet emerging warfighter requirements: ATD, ACTD, WRAP, RDC, JRAC, and RCIP.

To the uninitiated, the above programs would seem to offer an alternate path to ADSI for fielding the desired TDL capabilities. Their names alone make them seem viable candidates begging the questions, "did the program office even consider them? Could they have provided the desired capabilities sooner or cheaper?"

Close examination reveals that the listed programs are designed to solve particular acquisition challenges, each having very specific criteria. For example; ATDs are used to demonstrate technical maturity – ADSI was mature, ACTDs evaluate military utility – ADSI was already in use by the military, and JRACs are designed to counter new or emerging battlefield threats, which was not the case with the TDL requirements. Unfortunately, the requested TDL capabilities did not meet any of the accelerated acquisition programs criteria.

The ADSIs were fielded as an interim solution for meeting the TDL requirements. Given the requested capabilities, timeline, and available resources, there was no better solution, POR or otherwise. Although DoD acquisition has an array of programs designed to help speed delivery of capability, due to a range of reasons, from the unique capability request to the availability of an existing solution, none of the DoD accelerated fielding programs were applicable. The non-standard acquisition of ADSI was the best solution to meet the warfighter requirements. The only way to have prevented the non-

standard acquisition would have been to leave the validated warfighter requirement unfilled. That not being an option, the fielding of the ADSIs was not preventable.

C. REOCCURRENCE

Lessons learned, "knowledge or understanding gained by experience," is a hallmark of military operations (GAO, 2001). Prior to embarking on deployment, a major exercise, or maneuvers, all are admonished to read the "lessons learned" from previous efforts in order to understand the potential challenges and corresponding mitigation options. Likewise, upon returning from operations, the same folks are directed to write their "lessons learned" for the benefit of those who will follow. Unfortunately, in many cases, most lessons are actually lessons "relearned." Preventing the reoccurrence of non-standard acquisition is a matter of lessons learned. Can the DoD acquisition system learn from experience and in particular, can it learn from this particular lesson?

1. Successes

The DoD acquisition system is unique. It has neither a civilian counterpart nor a corporate equivalent. The system is immense in terms of size, scope of responsibility, complexity, expenditures, and number of employees. Yet, in spite of those significant challenges, the greater DoD acquisition system has demonstrated an ability to learn.

a. Acquisition Reform

Reform is the "improvement or amendment of what is wrong, corrupt, or unsatisfactory (Webster, 2002)." DoD acquisition has been in a process of reform for over 30 years. The establishment of the Defense Acquisition University was the result of lessons learned – the need for professional acquisition corps (Garcia et al, 1997). The substantial reform efforts of Deputy Secretary of Defense Wolfowitz clearly demonstrate that lessons are being learned.

b. Response to GWOT

The most recent example of DoD acquisition adapting or learning is its response to the GWOT's acquisition challenges. Today's enemy is resourceful and crafty. His tactics are constantly evolving as are his weapons and methods. Acknowledging the traditional acquisition processes could not deliver the required capabilities fast enough, the acquisition system responded with rapid capability fielding programs such as JCTD and JRAC. This responsiveness clearly demonstrates that the acquisition community is learning from previous experiences.

2. Challenges

The requested TDL capabilities were not unreasonable or extraordinary. They were listed in the JTDLMP and the Navy's tactical datalink roadmap. The problem was one of timing. The requested capabilities fielding's were years away.

a. Anticipation

It is an unrealistic expectation to be prepared for the unknown. The surprise attacks of September 11th caught the world off guard. That is the very nature of surprises, they occur suddenly and without warning. The attacks were unprecedented, the first of their kind and completely unanticipated.

b. Execution

The attacks of September 11th caught the DoD acquisition community off guard as well. Prosecuting the GWOT put a tremendous strain on DoD resources which impacted the acquisition system. Requests for capabilities poured in while resources remain unchanged. Although the desired TDL capabilities were "in the POR pipe line," delivering them early was not possible.

The warfighters' response to the surprise attacks was the proper articulation of requirements to their chain of command. The requests were validated and

forwarded to the program office for resolution. The program office was charged with and subsequently provided a solution, albeit a non-standard solution, to the unanticipated requirements.

In the process of providing the solution, the program office encountered numerous difficulties: an increase in requirements without corresponding increase in resources, inability to plan for the unexpected, inflexibility of long-range plans and roadmaps, and the rigidity of the acquisition system. Although these difficulties provided valuable "insight," they fell short of having the relevance of lessons learned as they simply confirmed the obvious; one can not prepare for the unknown.

3. Lessons Learned

Preventing reoccurrence is a matter of not repeating the same act, in other words, to learn the lesson. The DoD acquisition system is not stagnant, it evolves and reforms itself. The reforms are driven to make the system better and more responsive in meeting warfighter needs.

A key component of reform is improving upon mistakes, thereby benefiting from lessons learned. The non-standard acquisition of ADSIs produced some meaningful lessons.

a. DoD Acquisition System

In this post 9/11 era, the DoD acquisition system must continue to be responsive and help push that responsiveness to the lowest echelon possible. The services have to support that responsiveness by providing supplemental funding to support the immediate fielding of required capabilities.

Furthermore, the acquisition community must learn how to deliver capabilities sooner, particularly in the C4I arena. The slowness to field has been the driving force behind acquisition reform for over 30 years, yet capabilities are still taking 5 to 10 years to field; 5 to 10 years represents a generation (or two) of C4I technology growth. Fielding the ADSIs on Navy ships was not a technical challenge, the capability

was already proven. The ADSIs were fielded because the comparable PORs were not scheduled to be delivered for another four to six years. The acquisition system was too slow.

b. Community Relationships

In order to meet short-notice warfighter requirements, communication across the acquisition community will have to improve significantly. Time, more so then technology, is the limiting factor. No longer can the warfighter submit a request and hope it gets the proper funding and support, the process is too slow. The acquisition system needs a closer relationship with its customers.

Program offices need to engage the warfighter as their technical subject matter experts, eager for conversation and idea exchange with the operators. Gone should be the days of the program offices being faceless entities that deliver antiquated gear that the Fleet no longer wants. Technology growth demands continuous two-way conversation if acquisition is to deliver the right capabilities. The more the acquisition community understands the warfighter, the better they will be able to meet his needs. Likewise, the more the warfighter understands the acquisition process, the better participant he will be.

The TDL genie is "out of the bottle." As long as the warfighters' requirements remain unfilled and the technology easy and relatively cheap to acquire, complete elimination of non-standard C4I acquisition is not realistic. However, a significant reduction in reoccurrence is possible provided the acquisition community learns this lesson. Acquisition reform is making great strides. Secretary Wolfowitz's goal to "create an acquisition policy environment that fosters efficiency, flexibility, creativity, and innovation," is part of the lessons learned process (DSD, 2002).

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VI. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSIONS

Non-standard acquisition does not *just happen*. The DoD acquisition system is regulation-guided and process-driven. Yet in spite of layers of regulations and volumes of directives, non-standard acquisition of a C4I system occurred, the consequence of which was the reprioritization of program office funds. The corresponding reallocation of resources negatively impacted existing programs of record.

The non-standard acquisition was not a deliberate affront to the acquisition system, but rather a manifestation of the warfighters' frustration with delays in acquiring necessary capabilities. Fighting the GWOT brought unanticipated TDL communication demands that forced warfighters do as they have done throughout history, adapt, improvise, and overcome. Although the initial ADSIs were purchased directly from the manufacturer and outside formal acquisition, they proved effective and precipitated the demand and subsequent legitimate acquisition of the additional units that satisfied vital warfighter requirements. From the warfighter's perspective, the non-standard acquisition of the C4I technology was acquisition reform at work – "giving the warfighter what he needs when he needed it."

The GWOT's impact on the DoD acquisition system has been profound, touching practically every aspect of acquisition from the requirements generation process to resourcing. Whereas prior to 9/11 acquisition reform was a goal, it is now a forced reality. DoD acquisition is quickly transforming to meet the warfighters' needs. Innovative programs such as JCTDs, WRAPs, the JRAC, and to a lesser degree the non-standard acquisition of the ADSIs, are the most recent examples of how acquisition is becoming "more efficient, flexible, creative, and innovative."

Exuberance aside, DoD acquisition system is still facing significant challenges. The non-standard C4I acquisition forced the program office into a non-traditional role of developing a solution to a short-notice requirement. Although the eventual solution satisfied the requirements, it did so at the expense of other programs. The “robbing Peter

to pay Paul" acquisition under the guise of fighting the GWOT is not sustainable, jeopardizes proper systems acquisition, and must, to the greatest extent possible, be prevented.

The key to preventing or minimizing reoccurrences of non-standard C4I acquisition is to learn the lessons from this occurrence. One of the most important lessons learned is the vital role communication plays across the acquisition community of interest.

The program office had a plan to deliver the desired capabilities. The plan was the product of the acquisition's top-down requirements process. Unfortunately, the plan's timeline did not support the short-notice requirements and resulted in the non-standard acquisition of C4I capabilities. Had there been more communication between the program office and the warfighter, the program office might have been able to adjust their POR delivery during the 18 months the Fleet tried to solve the problem on their own. Greater communication could have precipitated dialogue between the program office and its resource sponsor, giving them more time to explore additional funding.

Whether the program office could have delivered the capability sooner is mute, as they were never given the opportunity. In retrospect, it is doubtful that the program office could have accelerated their PORs to meet the delivery schedule, but the lesson remains valid: warfighter demands will continue and having a better understanding of them sooner will greatly benefit both the program office and the warfighter.

Over the past five years, the DoD acquisition system has made significant strides in providing the warfighter "what he needed when he needed it." DoD reform efforts are starting to have an impact. The GWOT has changed the way that we go to war and how we field capabilities in support of the warfighter. Provided the lessons are truly learned, the likelihood of a reoccurrence of the non-standard C4I acquisition of equal magnitude is highly unlikely. Time may show the ADSIs' fielding to have been an unavoidable anomaly.

B. RECOMMENDATIONS

The growth of C4I technology is outpacing the DoD acquisition process. In order for the warfighters to maintain C4I battle-space dominance, the acquisition system must field C4I capabilities quicker. As intimidating as the task sounds, quicker fielding of C4I capabilities is achievable. No special commissions, panels of experts, or organizational shake-ups are necessary. The eloquence of the solutions lies in their simplicity: optimize existing regulations and directives that guide the process and foster greater warfighter/operator involvement.

1. Process Optimization

Slowness to field is not a C4I-unique acquisition problem. Due to the number, cost, and complexity of the capabilities ultimately delivered; DoD acquisition is large, cumbersome, and often perceived as overly slow. The acquisition system has been grappling with these challenges for years, the result of which being the various reform initiatives. The current DoD, CJCS, and DoN acquisition directives and regulations provide numerous paths to quicker fielding. Mandatory consideration of COTS and NDI capabilities is a good example of how the process fosters speed of fielding. Programs such as ACTD, RCIP, and the JRAC process are further evidence of how acquisition is trying to deliver warfighter capability more quickly.

If a goal of acquisition reform is to reduce the time required to field a capability, why then, despite procedures and programs along those lines, does slowness to field persist: in a word bureaucracy. The bureaucratic burden endemic to any large government organization impedes quicker fielding.

The acquisition process is a seemingly countless series of necessary steps, without which the process would fall apart. As vital as these steps are, unless expeditiously executed, they easily become an impediment to the process. The acquisition bureaucracy hinders any chance of expediency. Steps that should take days or weeks, end up taking months or longer, with each delay being propagated to following steps. The main cause of the delay is briefs: information briefs, decision briefs, program status briefs, budget briefs, milestone briefs, etc. As a rule, each brief requires supporting briefs which spawn

multiple iterations as they move up the chain of command and each of those brief requiring a pre-brief meeting. The subsequent delayed decisions invariably impact production which inevitably delays delivery of the required capability.

The entire acquisition community needs to be more aggressive as they advance through the necessary steps to fielding a capability. Decisions should be delegated to the lowest practical level, thereby reducing the number of briefings and approval "Inboxes." Providing the warfighters the capabilities they need when they need is them is the responsibility of the acquisition community. Every effort should be taken to exploit the numerous speed-to-fielding programs to do so.

2. Warfighter Involvement

Warfighter feedback is a key acquisition reform driver. If acquisition is to meet warfighter demands, particularly in the area of C4I, it can no longer be a faceless organization - it needs to engage the customer. Greater warfighter involvement in the acquisition process helps the acquisition community as well as the warfighter. Warfighter involvement will help ensure the right capability is being fielded. Additionally, it will help reduce non-standard acquisition and improve the speed of capability delivery.

The key component of the warfighters' involvement is dialogue; dialogue between the producers and the users. This dialogue is crucial to C4I programs where technology changes are such that a capability requested could be at risk of not being sufficient by the time it is fielded. Persistent dialogue over the course of a capabilities' development would help ensure the fielded capability meets the warfighters' needs. Currently, the warfighter does not effectively participate in the acquisition process after his initial requirements are received.

Warfighter involvement, particularly at the program office level, would go a long way in reducing non-standard acquisition and correspondingly inefficient expenditures of precious resources. No or poor communication between the warfighter and the program office could precipitate non-standard acquisition. In the case of the ADSIs, had the warfighters communicated their need and impending purchase of commercial capabilities

to the program office, the program office might have been able to help with the acquisition and, more importantly, become aware of the much-needed TDL capabilities. As that dialogue did not exist, the program office did not learn of the need for 18 months; 18 months that could have been spent developing a solution.

Greater warfighter involvement does not imply abandonment of formal acquisition procedures. Warfighter involvement forges a partnership of sorts that encourages collaboration throughout the entire acquisition process, rather than just the front end. The acquisition community can help by engaging the warfighter in dialogue through Fleet briefings, road shows of sorts, which communicate where the program office is heading, both near and long-term, thereby giving the Fleet a chance to provide their input.

C. AREAS FOR FURTHER RESEARCH

The DoD acquisition system is in a persistent state of "reform." Why, in spite of years of reform and an array of "acceleration" programs, does DoD acquisition continue to struggle to meet warfighter needs? The numerous reform efforts acknowledge the necessity for improvement and demonstrate the drive to make the process better. After 30 years of acquisition reform, perhaps the answer is not more reform, but rather better execution. Acquisition needs to stop reforming and start getting better.

Further research into two related areas, enforcement of existing governance and acquisition rigor, would be of interest and beneficial to the acquisition community.

1. Enforcement

Acquisition governance; the directives, regulations, and guidance, that describes how acquisition is supposed to work, does not provide significant enforcement mechanisms. Non-standard acquisition occurs because the existing system, by not preventing it, allows it. An examination of possible acquisition enforcements would be beneficial to the acquisition community.

2. Acquisition Rigor

Providing capabilities to the entire DoD is a monumental task requiring a very large work force and budget. Proper management of the acquisition workforce and execution of budgets necessitate volumes of rules and regulations. Without procedures and guidance, the DoD acquisition system would fall into chaos. The amount of reform to date might suggest the fall has begun. Acquisition rigor, the scrupulous adherence to process, would reduce unnecessary bureaucracy thereby speeding delivery of needed capabilities. Further research into this rigor would be beneficial to the acquisition community.

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